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VIEWS, NEWS AND INTERVIEWS.

A new steel shaft just finished for the Boston Elevated Railway Company, is said to be the largest ever cast. It is to be used in the company's central power station. The engine will be of 4,000 horse-power at ordinary speed. The shaft is 28 feet in length and 38 inches in diameter in the center and weighs about 75,000 pounds.

Twelve masked men entered the car barn of the Fairmount Park Electric Railway Company, in Philadelphia, a little after 1 A. M. on June 19, and after binding six of the employés forced open the safe and stole nearly $4,000, the receipts of the previous Saturday and Sunday.

It was reported in Wall street last week that Gen. Leonard Wood had been offered the presidency of the Washington Traction and Electric Company, of Washington, D. C. It is not believed that General Wood will accept. Rumor has it that he may be made military governor of Cuba.

The Duke of Orleans, the French pretender, while visiting Twickenham, near London, last week, was riding in an electromobile which collided with a hansom cab. The duke received a bad shaking up, and the electromobile was smashed.

A curious advertising novelty devised by a German inventor consists of a lightly silvered mirror, behind which is an electric lamp. Ordinarily the mirror reflects objects like other mirrors, but when the light is turned on behind it, the design at the back is brought to view. By flashing the light intermittently a novel effect is given.

A recent wind storm blew a large tree across the L. & N. track two miles north of Paris, Ky., and blocked the track for about an hour. The tree also broke down the telegraph wires for 200 yards. Chief Train Dispatcher H. H. Hancock went out on a freight to the scene to see about the accident, and took the Paris end of the wire and sent a message to the Paris office by merely tapping on the steel rails with the broken wire. The message came very faintly, but it was correctly taken by Dispatcher Bower, who was on duty.

Engravers always try to identify the illustrations they have made when they send in their bills, but sometimes they make mistakes. The cut of an electrical coffee roaster, printed in last week's issue of the ELECTRICAL REVIEW, was billed as an "astronomical sphere."

It is stated that the Pepperell Manufacturing Company, Biddeford, Me., the largest cotton manufacturers in that state, will substitute electricity, developed from water-power, for their present steam system, thus effecting a saving of $60,000 a year for coal.

Underground London contains 34,000 miles of telegraph wires, 3,003 miles of sewers, 4,530 miles of water mains and 3,200 miles of gas pipes.

It is reported that the Government of Trinidad has decided to adopt the Marconi system of wireless telegraphy for communication with the dependency of Tobago. Tobago is an island in the Windward group of the British West Indies, 32 miles long by 12 wide, 24 miles northeast of Trinidad. It was ceded to Great Britain by France in 1763.

A FEW OF THE MEMBERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. PHOTOGRAPHED BY DR. A. V GARRATT, BOSTON, JUNE 27, 1899.

POLYPHASE ELECTRIC TESTING.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, JUNE 26, 1899, BY PROFESSOR HARRIS J. RYAN.

It is not the object of this paper to take up the general subject of polyphase methods for making electric measurements, but to treat more particularly a method that employs a polyphase source for making instantaneous measurements of alternating currents or pressures without the use of a contact-maker.

Description of the Method—In the diagram of Fig. 1, T is a special transformer, with a closed magnetic circuit of soft, pure iron or "electrical steel," with the portion enveloped by the primary and secondary coils much restricted in area as compared with the remaining portion of the circuit. The circuit through each sheet is unbroken by joints, making it necessary to wind the secondary and primary by hand after the core forming the magnetic circuit has been built up. The primary coil is so proportioned that sufficient alternating current may be circulated in it to provide a maximum M. M. F. of about 500 C. G. S. per centimetre along the core at its restricted portion. Such exciting current may be taken from the secondary of an induction motor appropriated for the purpose, or from a set of phase-changing transformers. Under these circumstances the flux through the core of this transformer will cause saturation during 97 per cent of the time. The greater portion of the reversal of the flux will occur during 1.5 per cent of the time of one alteration. The greater portion, therefore, of the secondary electromotive force time integral will occur during 1.5 per cent of the time of one alternation, and at the instant when the exciting current passes through zero. The remaining portion of the secondary time integral of the electro-

motive force will be applied with symmetry throughout 98.5 per cent of the alternation, being maximum on either side of zero for the exciting current, and gradually diminishing to zero during the time in which the exciting current is attaining its maximum value. It is seen, then, that the main portion of the secondary electro-motive force will be delivered with great suddenness at the time when the exciting current passes through zero.

In dealing with 40 cycles per second this electro motive force will be delivered during 1.5 per cent of the time of one alteration or in about one five-thousandth of a second. It is seen also that the residue of the secondary electro-motive force constitutes an alternating pressure that is one-fourth cycle behind the primary exciting current. The cross-section of the restricted area of the magnetic circuit with reference to the amount of pressure applied in the primary circuit for excitation is proportioned so that the amount of irregularly delivered flux can not appreciably alter the exciting current, as it would otherwise be established from instant to instant.

The secondary of the transformer T is connected to the pressure circuit of a dynamometer—a Weston wattmeter does very well—through the field coil of which passes the current whose form is to be determined and which is set up by the source pressure through some appliance X. Let us call the sudden time integral value of the secondary electro-motive force e, the instantaneous value of the current c, the effective value of the residue of the secondary electro-motive force E and the effective value of the current C, then the reading of the wattmeter will be:

$W = e\,c + E\,C\cos\theta$, where θ is the angle of phase difference between E and C, from which we may deduce the value of c. The phase of the exciting pressure delivered by M S may be changed by moving the motor secondary, or by a proper change in the value of the combined polyphase electro-motive forces applied in the phase-changing transformers, as the case may be, and a new instantaneous value of the current corresponding to the above change in phase will be obtained. In the same manner other values of the current may be obtained until the form of the current curve is sufficiently well defined. To apply the correction $E\,C\cos\theta$ involves so much attention and labor, as to make this method valueless if it were not for the fact that it can be quite completely compensated for in the following manner: The exciting current through the primary of the transformer T is passed through the primary of a suitably designed open-circuit transformer O C T, and through the secondary of O C T the connection of the impulse secondary from T is made on its way to the wattmeter. The electro-motive force developed in the secondary of O C T will be one-fourth cycle behind the primary exciting current of the impulse transformer T and therefore in unison with the residue electro-motive force of the impulse secondary of T. The secondary turns on O C T are adjusted in number so that the electro-motive force generated will equal the residue electro-motive force of the secondary of the impulse transformer T so that when the connection through the secondary coil of O C T is reversed the residue electro-motive force of the T secondary will have been compensated for.

The reading of the wattmeter will then become $W = e\,e$, and since e is constant, the values of W will be proportional to e or the instantaneous values of the current.

By using a dynamometer voltmeter, such as the Weston type, in which separate terminals for the movable

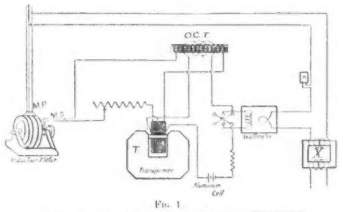

Fig. 1

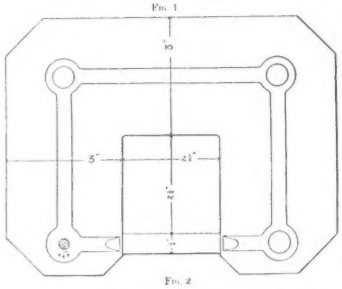

Fig. 2

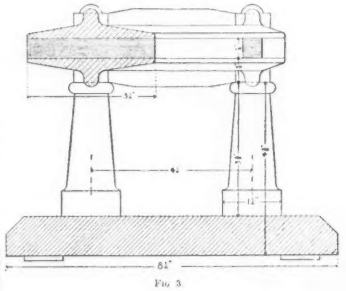

Fig. 3

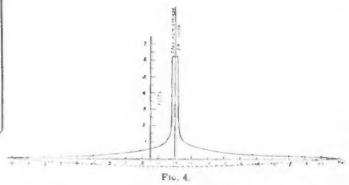

Fig. 4

FIGS. 1, 2, 3 AND 4.—POLYPHASE ELECTRIC TESTING.

pressure coil and field circuits have been arranged, the forms of alternating pressures and of tiny alternating currents may also be determined.

Thus this method is practicable only for instances where the plus and minus alternations are alike, which is the case in much alternate-current practice. Where, however, the positive and negative forms differ, one or more aluminum cells should be placed in series with the impulse secondary. Such cells have small internal resistance, and after having been charged with a direct current will completely cut off one side of the alternating impulse, provided the instantaneous pressure in the circuit at no time exceeds 20 volts per cell. Thus equipped the method may be used with Weston or similar make of instruments for form measurements in great variety and with ease and facility. This method is practically the same as Dr. Duncan's * except for the manner in which cyclic impulses are obtained.

A TRIAL OF THE METHOD.

At my suggestion a trial of this method was made by Mr. Lyman H. Brown during the Spring of 1898, in the laboratories at Cornell.†

Design and Construction of the Impulse Transformer—Figs. 2 and 3 give a plan and elevation of the transformer as constructed and used by Mr. Brown. The following are the important dimensions and specifications: The core was built up without joints from 10 mil Apollo "electrical sheets," from which the burr due to shaping was carefully removed. The oxide on the sheets afforded the only insulation against eddies. The frame for bolting the core together was of brass, it did not extend over the restricted section of the core. The bolts were thoroughly insulated from the core and brass frame. The supports and base were made of oak.

Number of turns in primary, 547.

Size of primary, 14 Brown & Sharpe gauge.

Number of secondary turns adjustable —.

Number of sheets, 48.

Thickness of a sheet, .01 inch.

Area of contracted cross-section of core, .25 square inch.

Area of uncontracted cross-section of core, 1.5 square inch.

Length of contracted section, 2.5 inch.

Total length of magnetic circuit, 10 inches.

Normal primary exciting current, three amperes.

On the assumption that a sufficient phase changing pressure is applied in the circuit, through the primary of this impulse transformer, so that the irregularities in the flux set up in the core will not appreciably alter the form of the exciting current, and with the aid of a B-H curve for the Apollo iron, I have calculated the following sequence of electro-motive force that will be set up per turn throughout one-quarter cycle in the secondary of this impulse transformer, when working at 40 cycles per second. The fractions in the time column give the portion of a quarter cycle that has lapsed since the exciting current passed through zero; the figures under B show the flux density in lines per square centimetre in the contracted section of the core, and the values under E in the brackets, showing the time interval over which they were estimated, give the average of the electro-motive force developed per volt in the impulse secondary.

Time.	B	E
0.00	0	
.01	12,500	....3.24
.02	14,900	..... .623
.03	15,800	
.04	16,400	
.05	16,860	
.06	17,200	.... .1065
.07	17,400	
.08	17,700	
.09	18,000	
.10	18,200	
.20	19,200	.... .0644
.30	19,800	
.40	20,300	.... .0258
.50	20,800	
.60	21,150	
.70	21,400	
.80	21,450	.... .00644
.90	21,500	
1.00	21,550	

The corresponding impulse curve of electro-motive force and time is given in Fig. 4 for a complete alternation. The broken curve shows the estimated compensating electro-motive force that should be provided by the secondary of the transformer O C T in Fig. 1.

Experimental trial made by Mr. Brown—A compensating open coil transformer was used that had the following dimensions:

Core of laminated iron, ring pattern	
Mean diameter of ring	8.75 inches
Cross-section	1¾ inch × 3⅛ inches
Air-gap	⅛ inch
No. of primary turns of No. 10 Brown & Sharpe gauge	121
No. of secondary turns, adjustable	

A 150-watt scale Weston wattmeter, wound for 150 volts and two amperes, was used as a dynamometer; the resistance of the pressure coil was cut down to a point where the instrument operated over a desirable range. Ten secondary turns were placed on the impulse transformer, T, and the same number was found necessary for compensation on the O C T transformer.

At X in Fig. 1 the secondary of the 10-light transformer reported upon in the Transactions, vol. viii, page 1, was connected through the field-coil of the watt-meter to one pressure of the tri phase source. The primary was kept on open circuit. By means of an auto-converter the source pressure was so adjusted that a normal flux was established in the core of the 10-light transformer X. For a phase-changer a Siemens & Halske three-horse-power, 33 cycle, tri-phase, four-pole, 110-volt induction motor with a ratio of transformation of approximately one, was used. By means of an index wheel and brake attached to the motor pulley, the motor secondary could be set to develop any desired phase for the exciting current of the impulse transformer. The phase-changing pressure was set at 100 volts, and the current controlled partly by reactance, and adjusted to the desired value of approximately three amperes, by means of a non-induction resistance. A complete reactance control and a higher phase changing source pressure would, however, have been better.

In Fig. 5 the unbroken curve is an alternation of the magnetizing current for the transformer at X, as obtained by Mr. Brown in the employment of this method, while the curve

* Transactions, vol. ix, p. 179.

† Thesis, Lyman H. Brown, Cornell University Library, T-1898, No. 30.

is the mean of the two alternations for the one given in Transactions, Vol. vii, page 12, as obtained by the contact - maker therein employed. The three-phase generator which supplied current for the experiments had its armature conductors distributed on a smooth core, and developed at no load a fair approximation to a sine curve of pressure. The full-load current output of this generator was 20 amperes, while the induction motor used for phase-changing required 10 amperes for field excitation. The armature reaction produced by this exciting current was comparatively large, causing the generated pressure curve to differ some from the pressure curve used at the time the original contact-maker measurements were made.

There is, therefore, a fair, practical agreement between the curve taken

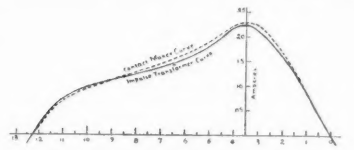

FIG. 5.—POLYPHASE ELECTRIC TESTING.

with the polyphase impulse transformer method and the curve taken with the contact-maker. It was found by Mr. Brown that 10 impulse-residue electro-motive force compensating turns were necessary, while my estimates showed that but five should have been necessary. This difference is probably due to the fact that the sheets were not annealed after they had been tooled into shape, and that complete reactance control of the exciting current for the impulse transformer was not used.

No experiments have been made in which the aluminum cell was used to cut out either the plus or minus impulses, so that the forms of unsymmetrical curves could be determined. Experimental data have been obtained by H. J. Hotchkiss,* from which it is seen that the aluminum cell will be found to be reliable for this purpose.

Department of Electrical Engineering, Sibley College, Cornell University.
June, 1899.

Chicago Will License Automobile Drivers.

Mayor Harrison, of Chicago, has directed the Law Department to draft an ordinance requiring operators of automobiles, and all other vehicles propelled through the public streets by electric or other mechanical devices, to be licensed. It is intended to subject the applicants to a rigid examination, and to bring the operation of horseless carriages under the supervision of the city authorities. The proposed ordinance will be introduced next week, and its immediate passage will be advised. The number of automobiles in use in Chicago is increasing so rapidly that regulations for protection are necessary. A number of accidents already have occurred by reason of incompetent operators.

* *Physical Review*, March, 1899.

REPORT OF THE COMMITTEE ON STANDARDIZATION.

SUBMITTED TO THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, JUNE 27, 1899.

TO THE COUNCIL OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

GENTLEMEN: Your committee on standardization begs to submit the following report, covering such subjects as have been deemed of pressing and immediate importance, and which are of such a nature that general agreement may be expected upon them.

While it is the opinion of the committee that many other matters might advantageously have been considered, as, for example, standard methods of testing; yet it has been deemed inexpedient to attempt to cover in a single report more than is here submitted. Yours respectfully,

FRANCIS B. CROCKER, chairman; CARY T. HUTCHINSON, A. E. KENNELLY, J. W. LIEB, JR., CHARLES P. STEINMETZ, LEWIS B. STILLWELL, ELIHU THOMSON.

GENERAL PLAN.

Efficiency—Sections 1 to 24:
- (I) Commutating machines, sections 6 to 11.
- (II) Synchronous machines, sections 10 to 11.
- (III) Synchronous commutating machines, sections 12 to 15.
- (IV) Rectifying machines, sections 16 to 17.
- (V) Stationary induction apparatus, sections 18 to 19.
- (VI) Rotary induction apparatus, sections 20 to 23.
- (VII) Transmission lines, section 24.

Rise of Temperature—Sections 25 to 31.
Insulation—Sections 32 to 41.
Regulation—Sections 42 to 61.
Variation and Pulsation—Sections 62 to 65.
Rating—Sections 66 to 73.
Classification of Voltages and Frequencies—Sections 74 to 78.
Overload Capacities—Sections 79 to 82.
Appendices—
- (I) Efficiency.
- (II) Apparent efficiency.
- (III) Power factor and inductance factor.
- (IV) Notation.
- (V) Table of sparking distances.

Electrical apparatus will be treated under the following heads:

I. Commutating machines, which comprise a constant magnetic field, a closed-coil armature, and a multi-segmental commutator connected thereto.

Under this head may be classed the following: Direct-current generators, direct-current motors, direct-current boosters, motor-generators, dynamotors, converters and closed-coil arc machines.

A booster is a machine inserted in series in a circuit to change its voltage, and may be driven either by an electric motor or otherwise. In the former case it is a motor-booster.

A motor-generator is a transforming device consisting of two machines, a motor and a generator, mechanically connected together.

A dynamotor is a transforming device combining both motor and generator action in one magnetic field, with two armatures or with an armature having two separate windings.

For converters, see III.

II. Synchronous machines, which comprise a constant magnetic field, and an armature receiving or delivering alternating currents in synchronism with the motion of the machine; i. e., having a frequency equal to the product of the number of pairs of poles and the speed of the machine in revolutions per second.

III. Synchronous Commutating Machines—These include (1) synchronous converters; i. e., converters from alternating to direct, or from direct to alternating current, and (2) double-current generators; i. e., generators producing both direct and alternating currents.

A converter is a rotary device transforming electric energy from one form into another without passing it through the intermediary form of mechanical energy.

A converter may be either

a. A direct-current converter, converting from a direct current to a direct current or,

b. A synchronous converter, formerly called a rotary converter, converting from an alternating to a direct current, or vice versa.

Phase converters are converters from an alternating-current system to an alternating-current system of the same frequency but different phase.

Frequency converters are converters from an alternating-current system of one frequency to an alternating-current system of another frequency, with or without changes of phase.

IV. Rectifying machines, or pulsating-current generators, which produce a unidirectional current of periodically varying strength.

V. Stationary induction apparatus; i. e., stationary apparatus changing electric energy from one form into another, without passing it through an intermediary form of energy. These comprise:

a. Transformers, or stationary induction apparatus in which the primary and secondary windings are electrically insulated from each other.

b. Auto-transformers, formerly called compensators; i. e., stationary induction apparatus in which part of the primary winding is used as a secondary winding, or conversely.

c. Potential regulators, or stationary induction apparatus having a coil in shunt, and a coil in series with the circuit, so arranged that the ratio of transformation between them is variable at will.

These may be divided into:

1. Compensator potential regulators, in which the number of turns of one of the coils is changed.

2. Induction potential regulators, in which the relative positions of primary and secondary coils is changed.

3. Magneto potential regulators, in which the direction of the magnetic flux with respect to the coils is changed.

d. Reactive coils, or Reactance coils, formerly called choking coils; i. e., stationary induction apparatus used to produce impedance or phase displacement.

VI. Rotary induction apparatus, which consist of primary and secondary windings rotating with respect to each other. They comprise

a. Induction motors.
b. Induction generators.
c. Frequency changers.
d. Rotary-phase converters.

EFFICIENCY.

1. The "efficiency" of an apparatus is the ratio of its net power output to its gross power input.*

2. Electric power should be measured at the terminals of the apparatus.

3. In determining the efficiency of alternating-current apparatus, the electric power should be measured when the current is in phase with the electro-motive force, unless otherwise specified, except when a definite phase difference is inherent in the apparatus, as in induction motors, etc.

4. Mechanical power in machines should be measured at the pulley, gearing, coupling, etc., thus excluding the loss of power in said pulley, gearing or coupling, but including the bearing friction and windage. The magnitude of bearing friction and windage may be considered as independent of the load. The loss of power in the belt and the increase of bearing friction due to belt tension should be excluded. Where, however, a machine is mounted upon the shaft of a prime mover, in such a manner that it can not be separated therefrom, the frictional losses in bearings and in windage, which ought, by definition, to be included in determining the efficiency, should be excluded, owing to the practical impossibility of determining them satisfactorily. The brush friction, however, should be included.

a. Where a machine has auxiliary apparatus, such as an exciter, the power lost in the auxiliary apparatus should not be charged to the machine but to the plant, consisting of machine and auxiliary apparatus taken together. The plant efficiency in such cases should be distinguished from the machine efficiency.

5. The efficiency may be determined by measuring all the losses individually and adding their sum to the output to derive the input, or subtracting their sum from the input to derive the output. All losses should be measured at, or reduced to, the temperature assumed in continuous operation, or in operation under conditions specified. (See Sections 25 to 31.)

In order to consider the application of the foregoing rules to various machines in general use, the latter may be conveniently divided into classes as follows:

I. Commutating machines.

6. In commutating machines the losses are:

a. Bearing friction and windage. (See Section 4.)

b. Molecular magnetic friction, and eddy currents in iron and copper. These losses should be determined with the machine on open circuit, and at a voltage equal to the rated voltage $+ Ir$ in a generator, and $- Ir$ in a motor, where I denotes the current strength, and r denotes the internal resistance of the machine. They should be measured at the correct speed and voltage, since they do not usually vary in proportion to the speed or to any definite power of the voltage.

c. Armature resistance losses, I^2r', where I is the current strength in the armature, and r' is the resistance between armature brushes, excluding the resistance of brushes and brush contacts.

d. Commutator brush friction.

e. Commutator brush-contact resistance. It is desirable to point out that with carbon brushes the losses (*d*) and (*e*) are usually considerable in low-voltage machines.

f. Field excitation. With separately excited fields, the loss of power in the resistance of the field coils alone should be considered. With shunt fields or series fields, however, the loss of power in the accompanying rheostat should also be included, the said rheostat being considered as an essential part of the machine, and not as separate auxiliary apparatus.

(*b*) and (*c*) are losses in the armature or "armature losses;" (*d*) and (*e*) "commutator losses;" (*f*) "field losses."

7. The difference between the total losses under load and the sum of the losses above specified should be considered as "load losses," and are usually trivial in commutating machines of small field distortion. When the field distortion is large, as is shown by the necessity for shifting the brushes between no load and full load, or with variations of load, these load losses may be considerable, and should be taken into account. In this case the efficiency may be determined either by input and output measurements, or the load losses may be estimated by the method of Section II.

8. Boosters should be considered and treated like other direct-current machines in regard to losses.

9. In motor-generators, dynamotors or converters, the efficiency is the $\frac{\text{electric output}}{\text{electric input}}$.

II. Synchronous machines.

10. In synchronous machines the output or input should be measured with the current in phase with the terminal electro-motive force, except when otherwise expressly specified.

Owing to the uncertainty necessarily involved in the approximation of load losses, it is preferable, whenever possible, to determine the efficiency of synchronous machines by input and output tests.

(To be continued.)

* An exception should be noted in the case of storage batteries or apparatus for storing energy, in which the efficiency, unless otherwise qualified, should be understood as the ratio of the energy output to the energy intake in a normal cycle.

SCIENCE BREVITIES.

The Liquefaction of Hydrogen—The last of the so-called permanent gases has succumbed to the attacks of the scientist. Those who were privileged to witness the lecture by Professor Dewar at the Royal Institution Centenary, says the *Mechanical Engineer*, had the opportunity of seeing, in substantial quantities, hydrogen in a liquid state, the fluid being at once the lightest and the coldest ever known. To the physicist the event is no ordinary one, and the eminent and distinguished company to whom the experiment was first made public was a tribute to the keen interest which it excited. Under the influence of the enormous pressures and intense degrees of cold now obtainable with the appliances of modern science, the various "permanent" gases have during the last few years proved to be subject to the same immutable laws as other elementary bodies. Their existence as a solid, a liquid, or a gas being entirely a question of condition as to temperature and pressure. The enormous mechanical difficulties that have had to be surmounted, however, in order to obtain a temperature so low as 21 degrees centigrade on the absolute scale—that is, a temperature of 242 degrees centigrade below the freezing point of water—are difficult to realize except by those engaged in such experimental work, and the result has only been obtained by Professor Dewar at great financial expense, aided with the unrivaled facilities afforded by the Royal Institution Laboratory. The event was a fitting commemoration of the centenary of the building so closely connected with the memories of Davy and Faraday, and, as Lord Kelvin truly remarked, serves to measure the enormous strides in scientific research that have been made during the century now closing; and could those eminent experimenters have visited the scenes of their former labors, they would scarcely have hoped to see their scientific dreams and prophecies so splendidly verified at the present day. From Lord Kelvin's remarks it would appear that the end of experimental research in the direction of low temperature has not yet reached finality, for he ventured to suggest the possibility of the experimenter in the next few years coming to within five degrees of the absolute zero.

Acoustic Properties of the Arc—Last year, says the *Electrician*, H. T. Simon announced that the electric arc, being very sensitive to air waves, and also to slight currents in a neighboring conductor, could be used as a telephone transmitter or receiver by placing it in the neighborhood of a circuit containing a microphone. O. Hartmann has further investigated this phenomenon. He places the primary of an induction coil in the continuous-current circuit feeding an arc lamp. On pulling the carbons apart, so as to obtain as long an arc as possible, a loud note is heard on joining the terminals of the secondary, on inserting a condenser between them, on touching one terminal with the hand, or putting it to earth. In touching it with the hand, it does not matter whether the person is insulated or not. This shows that the only condition required is an increase of capacity; in fact, the same phenomenon is produced when the terminal is connected with the inner coating of a Leyden jar. The note is also produced by simply enclosing the primary coil in a metallic cylinder, and the tone is that to which the cylinder itself resounds. The author thinks that these notes explain the sounds often heard in continuous current arcs. The lamp mechanism usually contains coils and metallic enclosures. The obvious remedy is to avoid capacities, and to increase, if necessary, the inductance in the circuit.

Long Spans of Overhead Wires—Professor Juellig, in an article in the *Zeitschrift für Elektrotechnik*, gives the maximum spans possible for wires of different materials, on a basis of a factor of safety of 4. For cast-steel wire, 3.42 miles; for silicon-bronze, 1.56 miles to one mile, depending on the quality; for wrought-iron, 1.02 miles; and for soft copper, .53 mile. These maximum spans are independent of the cross section of the wire, for although the weight of the wire increases with the cross-section, its strength increases in the same proportion. These spans do not allow for wind pressure or for snow or ice. The figures are of interest as showing the possible limits.

Damp Coherers—Since his discovery (described in the ELECTRICAL REVIEW for April 19, 1899) of a curious kind of anti-coherer in the shape of a gap between metallic deposits on glass bridged by a film of moisture, A. Neugschwender has studied the action in question more closely, and has arrived at what appears to be a satisfactory explanation. This is abstracted by Mr. Fournier d'Albe from *Wiedemann's Annalen*, as follows: It seems that the increase of resistance under the influence of electric waves is only observed when the moisture contains a salt, and when that salt is capable, under electrolysis, of separating out pure metal. This at once suggests that a metallic electrodeposit is at work, and observation of the gap through the microscope confirms that supposition. On sending a current through a gap in a platinum deposit bridged by a drop of silver nitrate, minute, tree-like structures of silver are seen to form at the cathode. These gradually extend across towards the anode, thereby considerably diminishing the resistance encountered by the current. When electric waves impinge upon the gap, sparks proceed from the ends of the branches, and the trees are broken up into small pieces, which appear considerably agitated. On the cessation of the waves the pieces cohere again more or less, and the original conductivity is partially restored. Hence the "self-righting" action observed. The resistance may thus vary between 50 and 90,000 ohms. Aschkinass has shown that thin moist films are not necessary, but the action in liquids observed by him is as yet unexplained.

Electrolytic Conductivity without Electrodes—We hear so much about electrolytic conductivity and migration of the ions from and to electrodes that we may be puzzled to say how an electrolyte should behave with regard to induced currents in the absence of electrodes. An account of an interesting experiment which Dr. Behn-Eschenburg describes appears in *Engineering*. He built up a closed-circuit transformer, consisting of four limbs of square section, two 30 inches long, two 10 inches united to a square frame. The primary coil of 20 turns was put on one limb. Around one of the vertical limbs he fitted a trough filled with a solution of sodium carbonate. The trough had a cross-section of 360 square centimetres (56 square inches) and a total length of 185 centimetres (73 inches). By inserting two electrodes in such a way that the testing current could flow through the square trough both to the right and to the left, the resistance of the two-trough halves in parallel was found to be 2.42 ohms, which means a resistance of 10 ohms for the whole liquid column. During the experiments, exploring electrodes were put in the solution at various points; these electrodes were connected to a voltmeter V_1. The induction was measured by a secondary copper coil placed near the trough and connected to a voltmeter V_0. Further, a constantan wire, equivalent in resistance to the liquid, was fixed round the transformer close to the trough. If then the electromotive force E_0 measured directly on the copper coil, agreed with the electro-motive force E_1 derived from measurements in the trough, and with measurements made on the constantan wire, it would follow that under the conditions of the experiment the liquid behaves just like a metallic conductor of equivalent resistance. The experiments were conducted during the course of an investigation of transformers, and were not pushed to the highest degree of accuracy, since there was no theoretical problem to solve. They are quite sufficient, however, to prove that the liquid coil really replaces a metallic coil. The transformer received alternating currents of 50 periods, 60 amperes at 150 volts. The exploring electrodes of V_1, a caloric instrument of Hartmann & Braun, were inserted at various points of the trough across the liquid or parallel to its walls, or in contact with the walls. The electrodes were copper plates or wires, the influence of the shape of the electrode was not large, but distinct. Although the exact determination of the respective length of electrolytic column in circuit would have required a great deal of care, the agreement between the calculated and the observed quantities was, on the whole, very satisfactory.

An Electrolytic Platinum Alloy—Dr. Foveau de Courmelles, writing in *L'Electricien*, describes a new alloy of platinum formed on the surface of the anode of a Wehnelt interrupter of the usual form. The anode wire had previously been coated with silicate of potash. On forcing the current to an extreme point there was a sudden interruption, and the formation of a brilliant yellow metallic layer on the platinum wire, probably a silicide of platinum.

Helmholtz Memorial Statue.

A statue of von Helmholtz, the great German physicist, was unveiled in Berlin on June 6, in presence of the German Empress and the Crown Prince Frederick, who represented the Emperor. The statue, which is by Prof. Ernst Herter, is of white Tyrolese marble, and represents von Helmholtz in an academical gown over evening dress. It is placed in the garden in front of the Berlin University. The pedestal is of red Bavarian marble, and bears the plain inscription, "Hermann von Helmholtz, 1821–1894."

As to City Noises.

[*From the Denver, Colo., Post.*]

A writer in the ELECTRICAL REVIEW is of the opinion that we are rapidly approaching the period when cities will be noiseless, a condition devoutly to be wished. The fact of the matter is that, on account of the noisy city, a large part of the population is suffering from auricular defects brought on by the multifarious noises not indispensable to city life, but needlessly augmented in various ways. The writer in the ELECTRICAL REVIEW argues that, with the passing of the horse and the coming of the rubber-tired automobile, the chief cause of city noise will be abolished.

One could sincerely hope so, but it will not. There is the screeching locomotive and the intolerable fac tory whistle; there is the abominable street-car gong, the sonorous tamale man, and the no less vocalistically enthusiastic banana man. And there are others too numerous to mention. The noiseless city of the living is something this generation might appreciate, but will never realize. It is needless to point to the fact that noises which might be obviated without inconvenience to any one are rather on the increase, thereby making death more desirable but less easy. Before we shall have the pleasure of living in a noiseless city the major part of our city people will be suffering from auricular defects.

It is somewhat surprising that these defects, constantly on the increase as they are, should not attract more notice and cause a greater agitation for the suppression of the multifarious disharmonies produced from early dawn till late at night. Persons with a well trained sense of hearing, such, for instance, as musicians, are frequently driven almost to nervous insanity by the conglomeration of noises pouring in upon them from all sides. The disappearance of the horse from the city streets will lessen the noise to some extent, but will the automobile coming in its place be without a gong, and if not, why not? While the inventor of the gong dwells in a noiseless city to-day, those afflicted by his invention often wish he would have removed himself there before he invented it.

At the recent meeting of the American Society of Civil Engineers, at Cape May, N. J., Mr. Oberlin Smith said it would not be long before rubber-tired locomotives will be running between New York and Philadelphia, making the distance in half an hour. He said it is merely a question of designing proper rails.

Electric Lighting of the Greater America Exposition.

The Omaha Electric Light Company will furnish the current for the numerous arc lamps scattered about the grounds and the half-mile race track, and for the commercial lighting on the Midway. On the Bluff Tract the number of lights have been increased over last year's by more than 3,000, and 187 additional arc lights have been placed about the grounds.

A NIGHT VIEW OF THE GRAND COURT AT THE GREATER AMERICA EXPOSITION, OMAHA.

This means much, but the 15,000 additional lights arranged about the Grand Court means more. The effect was superb last year; this year will surpass all previous efforts.

The illustration shown herewith gives an idea of the effect when darkness falls and the white city of the day gives place to the fairy city of the night.

The description below of the scenes to be expected was written by Mr. J. W. Cutright, the superintendent of the Department of Publicity:

"Let the mind's eye picture a great quadrangle more than 2,000 feet in length, in the center a beautiful lagoon of rippling water, and along its banks the walks and fairy gardens, the whole scene shut in on all sides by the magnificent buildings lifting their gilded domes, and minarets, and spires high into the shades of night, each outline clear cut with rows of glowing lights, each massive pillar and classic arch defined and gleaming snow-white in the soft radiance. Upon the mighty buildings the groups and heroic figures stand out as though imbued with life and frozen into place by the very wonder at the scene below, where glowing stars of light define each balustrade and reach of pillared colonnade. Around the borders of the lagoon and on its bridges stand rows of clustered lights reflected in the waters and magnified a hundred fold. The plats of fairy gardens scattered here and there bloom bright with countless flowers which peep out from the green foliage and rival nature's hues in brilliance. More than 3,000 lamps beneath colored globes molded in the shape of flowers are used in producing this beautiful effect, and these lights lend the touch of color that is necessary to complete and finish out the picture. At the western end of the lagoon the electric fountain throws high in air its spray of changing colors, now clearest white, and now with all the colors of the rainbow glittering and flashing on the vision. Truly a fairy scene—grand, inspiring and beautiful."

Not Won By One.

[*From Publicity, London.*]

One step won't take you very far,
You've got to keep on walking;
One word won't tell folks what you are,
You've got to keep on talking.

One inch won't make you very tall,
You've got to keep on growing;
One little "ad." won't do it all,
You've got to keep 'em going.

One Million Dollars for a Telephone Repeater and Quadruplex.

Pres. Chas. J. Glidden, of the Erie system of telephone companies, has sent the following communication to the Boston *Herald* regarding his $1,000,000 offer for a telephone repeater and a telephone quadruplex, recently made through the columns of the New York newspapers:

Judging from the large number of letters I am receiving from all over the country, and the communication of Mr. Gorham Gray, dated the 20th, and published in a recent issue of your paper, regarding the offer of $1,000,000 for a telephone repeater and $1,000,000 for a telephone quadruplex, electrical scientists evidently misunderstand the offer, and infer that the sum is to be set aside to be drawn upon by inventors to assist them in their efforts to produce the apparatus desired. The offer covers the assignment to the undersigned of a telephone repeater or a telephone quadruplex covered by United States patents, the instruments, when used on telephone circuits, to produce the same results, telephonically speaking, as the telegraph repeater and quadruplex in the workings of a telegraph circuit. Very truly yours,

CHAS. J. GLIDDEN.

Judge J. D. Cleveland, one of the most prominent members of the Ohio bar, died at his home in Cleveland on June 29. He leaves a window and three children, among them being Mr. W. B. Cleveland, president of the Forest City Electric Company, of Cleveland.

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THE INSTITUTE MEETING.

The general meeting of the American Institute of Electrical Engineers at Boston, last week, was one of the most interesting and successful in the history of that body. Perhaps the most important paper presented was that by Mr. Steinmetz on the application of the complex imaginary algebra to double-frequency quantities—power, torque and the like. The fact that this instrument of analysis, while apparently hard of comprehension, is really extremely simple in use is not generally known. Nevertheless, it seems destined to play no unimportant part in the future of alternating-current study, for the elegance, facility and real simplicity of its methods make it greatly superior to any other scheme of analysis for this variety of work.

The position of the Institute in the matter of grounded secondaries is likely to meet with almost universal indorsement. The attitude of the Board of Underwriters toward this important matter has been clearly incorrect in the past, but the great conservatism of that body makes a change of its views infrequent and difficult. It is greatly to be hoped that the position of the Institute in reference to this matter will result in a change of the wiring rules to conform with it.

It was somewhat strange that no greater interest in electromobiles marked the meeting. Despite two excellent papers upon this subject, there seemed to be no unusual attention paid to this vitally important subject. There can be little doubt that the next great step in the electrical advance will be the conquest of the field of vehicular traction. The new industry occupies to-day much the same position that was filled by the electric street railway twelve years ago, and no one seriously contemplating the present state of the new art, the vast field open to the electromobile, or the great popular interest in automobilism, can fail to see that the future contains some such another great development in this line. No gift of prophecy is needed to foresee the future of the electromobile.

The efforts of the Entertainment Committee, composed of members of the Institute residing in Boston, deserve much credit for their successful outcome; for all the members worked hard in behalf of their visiting colleagues. The entertainments and excursions that were arranged were most enjoyable, and all who attended the 1899 general meeting will look back with pleasure upon Boston and their gathering in that hospitable city.

AMERICAN-MADE DEEP-SEA CABLES.

The era of expansion which is so confidently predicted by observers of current events—the opening of the vast area and vaster resources of China to the competing markets of the world—the planting of advance-stations of progress in the Philippine islands, all necessitate continual growth in the world's cable system. Roughly speaking, the main lines of telegraphic communication run a little more than two-thirds of the way around the globe. Coming eastward from the Pacific coast of North America they cross this continent, cross the Atlantic in many places, sweep across the vast areas of the Eurasian continent southeastward to India and Australia, while the coast lines of Africa and eastern Asia are looped and fringed with deep-sea cables. But a telegram from San Francisco to Yokohama or Manila must go eastward over this long course—there is no direct line across the Pacific. News of trade or war must pass almost around the world to bridge the relatively short gap between West and East; and this at great cost of both time and money. The demand, therefore, for direct cables from the west coast of the United States to Japan, China, the Philippines and Australia is exceedingly urgent. More than this, better cable facilities are needed all about the island region known as Oceania—now so evidently destined to play an important part in the westward march of civilization.

The opportunity thus presented to makers of cables is unprecedented. The demand is peremptory; the supply should be immediately forthcoming. But will American makers receive a substantial proportion of the millions that will be paid for the new cables?

It is most gratifying to be able to say that they will. Already movements are being made toward the erection of plants in this country for the manufacture of deep-sea cables, and some American-made cable is at this writing being laid in the far East. Americans are so vitally interested in the new lines of communication that they should spare no effort to keep them in American hands—and it would be bad for American prestige to let the cable contracts go to Germany or France, or even to England.

CONCERNING PROMPTNESS.

It is only once in a great while that boasting is permissible—but there are times when the consciousness of having done something unusually well so appeals to us that we feel like letting people know about it. This is just the position in which the ELECTRICAL REVIEW finds itself. Last week's number contained full and complete reports of the meeting of the American Institute of Electrical Engineers, in Boston, and the Telephone Convention, in Chicago: full, in that they gave all the essential facts; complete, in giving the news of both meetings up to the closing hour.

Our esteemed contemporary in this field of journalism dismissed the Telephone Convention with five and three-fourth lines, and the Institute meeting with two columns covering the first day's session. The accounts of these meetings in the ELECTRICAL REVIEW were seven and one-fourth and ten columns long, respectively

A wonderful amount of telephone construction is under way in the West and Northwest, and considerable additions to long distance lines are being erected daily. In the large cities, especially in the East, telephone engineers are devoting their attention principally to methods of rapidly caring for the enormously increasing traffic which, in some instances, grows so fast as almost to get beyond control. The telephone has come to be the mainspring of business.

THE INDEPENDENT TELEPHONE CONVENTION.

PAPER ON THE VALUE OF LONG-DISTANCE TOLL-LINES, BY S. P. SHEERIN—THE DISCUSSION.

At the convention of the Independent Telephone Association in Chicago, last week, the address by Hon. S. P. Sheerin, of Indianapolis, brought out considerable discussion. It was entitled "The Value of Long-Distance Toll-Lines," and is, in substance, as follows:

The toll-line is the youngest child of the telephone family; the latest comer, but the strongest and most robust of them all. Without in the least disparaging any of the branches of the great telephone industry, it must now be conceded that the toll-line takes precedence of all others in importance and general usefulness to mankind.

The telephone toll-line has brought the sons of men closer together than they have ever been since that bright morning, long ago, when Noah left the ark.

We must bear in mind that the real development of the toll-line dates from the inauguration of this independent movement. The farmer and the resident of the small town never had any place in the consideration of the men who owned the telephone patents, so long as they were in force. But the people of this country, when they want a thing, always find a way to get it. The fellow who does not serve the people when he can, is not always given a second chance. The telephone monopoly utterly failed to cover the field.

Parenthetically, I would like to make a bit of prophecy right here; that is a thing that will not be possible 20 years hence. The law-makers and courts of this country will not continue to allow a patentee to deny the benefits of his invention to people who are willing to pay for it. It is all right for the patentee and his assigns to have the right to enforce ample compensation, but this country will not continue to permit oppressive denial of benefits to men who are willing to pay for them.

The independent toll-lines of the United States are not more than four years old, and there are over 45,000 miles of them. No other one interest in the world has ever shown a development equal to this in the time. They are not all good lines. They could not have been owing to the conditions under which they were brought forth. All the early ones were built with the noisy threats of patent litigation, damage suits, etc., ringing in the ears of the builders. Still there is not a foot of independent toll-line, no matter how bad, that hasn't served a good purpose. They have all been educators.

The toll-line in the farming district is a veritable godsend. The telephone means more to the farmer than to the man in town. Distances with him are greater, and social intercourse more difficult. His protection, too, is very much less than that of his brother of the town. All these things the telephone gives him. It gives his ear to his neighbor, and his neighbor's ear to him. The farmer toll-line is already as much of an institution as the farmer's barn. The more farmers there are who have telephones the more townspeople there are who will have to have them.

The question now is, how to make these toll-lines most serviceable and most profitable to their builders and operators. My answer to this is in three words—"build good lines."

Notwithstanding the shortness of the time since the beginning of this independent toll-line movement, it is already far beyond the experimental stage. There is now no earthly excuse for putting up poor toll-lines. The toll-line business to hold its own must line up with the other construction of the country. We have left the log house and the rail fence a good ways behind. The corduroy road is a thing of the past, and wheat is no longer thrashed with flails. Discourage the putting up of anything but metallic lines, on good cross-armed poles close enough together. For the farmer to have the best results from his 'phone he should be able to talk with ease from his house to all the towns in which he is likely to have business.

Fair arrangements, based upon absolute equity should be entered into by all companies for an interchange of toll business. Public tolls tations should be as close together as possible, and these should always be in the hands of obliging and capable people. Rates should be such as will give fair remuneration, and, as nearly uniform as possible. Between the larger lines, interstate arrangements should be made for through business with the smallest possible amount of red tape. The whole independent movement has a field and a mission peculiarly its own. There is no longer such a thing in this country as a telephone monopoly. There are now two large telephone interests. One a mere bantling, scarcely more than four years old, which has not yet fully come to a realization of its own strength and importance. The other an elderly, sedate and somewhat reflective sort of monopoly, making what may or may not be an honest effort to atone for the numerous indiscretions of its past. The bantling now sets the pace and leads the way in every telephone contention on this continent, and the other follows with a more or less vigorous "me too."

The small towns and country districts of this country would have been without telephone service forever, but for this independent movement. The other people, now that the independents have blazed the way, meekly fall in line with smiling face and arms filled with telephones, and softly chant "me too." I am not at all anxious about the result; the people of this country know a good thing when they have it.

This independent movement needs but one thing, and that is close and intelligent organization. Its interests and dangers are identical in every town, county and state of this Union. It is a giant in strength, and a Dewey squadron in possibilities, if it but act unitedly. The toll-lines should be the band and bond of union in this independent movement. They are the spinal column, the nervous system and the circulating blood of the whole thing. No exchange can live without good toll-line connections, no more than toll-lines can live without exchanges. Their fortunes are inseparably linked.

All possible encouragement should be given to the putting up of good toll-lines. Toll-line rates should be as nearly equitable as they can be made, and toll-line companies should treat all exchanges absolutely alike in the division of tolls. There should be no paralleling of each others lines when it is at all possible to avoid it, and the exact relations of companies to each other should be set out in long-time written contracts. In short, everything should be done that can be done to put the whole movement on a strictly business basis. The world will never be without telephones nor without toll-lines. Within five years every fourth house in the United States will have a telephone. Let us see to it that they have ours and are pleased with them.

THE DISCUSSION.

Mr. DeLand: The independent people could make a good point by taking up the question of toll-lines on the Sabin system. Mr. Sabin has made a signal success by cutting up the minute into halves and three-fourths. Very few people understand that they can talk 70 words in 30 seconds. Take out your watch sometime and see how many words you can speak, speaking slowly, in 30 seconds; then 45 seconds and then 60 seconds. He gives a rate of 10 cents where the three-minute rate would be 30 or 35 cents. Very often men will come into your exchange who do not care to pay 35 cents to talk to a neighboring town because they have very few words to say. A man can possibly close a deal in 20 or 30 words. If he can get a 10 cent rate and occupies the line less than a minute, including connection, your line is open ready for the next customer. Out along the Sacramento River the Chinamen have a habit of sending messages into San Francisco and receiving messages in return in regard to their garden truck. They raise vegetables for those two cities and they do a very large amount of talking over the line. They have Chinese operators at the various stations to receive the messages. There is another point that Mr. Sheerin made that was quite interesting to me, and that is the advisability of building as strongly as possible. I noticed an item in one of the electrical papers the statement that you could build a

(Concluded on page 14.)

PERSONAL.

Col. S. G. Booker, of the Phœnix Battery Manufacturing Company, St. Louis, arrived in New York city last week.

Mr. J. F. Blauvelt, of the New England Butt Company, Providence, R. I., was a recent visitor to New York city.

Mr. Dexter B. Potter, president of the Providence Telephone Company, Providence, R. I., sailed for Europe last Saturday, and will spend the Summer season abroad.

A Long-Distance Electromobile.

On Sunday, July 2, says the Paris *Figaro*, the distance from Paris to Rouen was covered by an electromobile on a single charge of its battery. This feat was performed by the Comte de Chasseloup-Loubat, a devotee of electric locomotion.

Accompanied by one passenger, he drove himself the carriage with which he experimented at Achères. He started at half-past three o'clock in the morning and reached Rouen about eleven o'clock, covering 136 kilometres (84 miles) in 7 hours and 15 minutes, stoppages being deducted.

The travelers spent the afternoon at Rouen, and, the accumulators having been recharged, left there about eight o'clock, reaching Paris about four o'clock in the morning. The time on the return journey was seven hours and a half, stoppages included.

Wall Street and the Electrical Stock Market.

Wall street adjourned, July 1, for a rest of three days, with all the standard stocks fairly strong. General Electric closed at 118. Brooklyn Rapid Transit was a little weak on account of the rumors of a strike, the likelihood of which, however, was afterward happily dispelled by a very satisfactory interview of a committee of the motormen with President Rossiter. It closed at 115½. Electric Vehicle common closed at 102. Other electrical stocks closed about the same as the week previous. A rise of two points occurred in Electric Company of America, in Philadelphia.

Municipal Ownership in Crimson Gulch.

[*From the Washington, D. C., Star.*]

"I suppose you are not troubled with questions of municipal ownership and the like," said the stranger in Crimson Gulch.

"Yes," answered Derringer Dan, with a glance of suspicion; "sometimes we do. Once in a while some tenderfoot comes along and thinks he owns the town, but he gets over it in a minute or two."

The Electrolytic Chlorate Works at Chedde, Savoy.

BY JOHN B. C. KERSHAW.

Chemical works have in the past usually been grouped together in close vicinity to coal fields or salt deposits; and allied with other manufacturing establishments—such as glass works—they have formed great industrial centers. In England such a center exists in South Lancashire. The chemical works of the future will be, however, in many cases, isolated units, placed in mountainous districts, the chief conditions requisite being water-power and railway communication.

Ten years ago the world's consumption of chlorate of potash was wholly produced by the older chemical method. To-day, more than half the chlorate production is the output of electrolytic factories; and the writer has little doubt that 10 years hence the proportion of the total production made by the electrolytic method, with the aid of water-power, will be considerably increased.

The following facts may be given to show the progress of the new method of manufacture. In 1889 Messrs. Gall and Montlaur started the first electrolytic chlorate works at Villers-sur-Hermes, in Switzerland; utilizing a few hundred horse-power from the falls in the neighborhood of the place for this experimental work. At the end of 1898—or nine years later—there were seven electrolytic chlorate factories in operation, all operated by water-power, utilizing 30,000 horse-power, and producing 6,500 tons chlorate per annum. Two new electrolytic chlorate factories were also under construction in 1898; and the fact that one of these is promoted by the United Alkali Company—the chief producer by the older method of manufacture—is highly significant.

In a previous article on this manufacture, the writer was able to give a detailed description of the St. Michel Works of the Societe d'Electrochimie, where the Gall and Montlaur process is operated on an extensive scale. In the present article he is able to present a similar account of the more recently built factory of the Societe des Forces Motives de l'Arve, which carries on the manufacture of chlorate under the patents of M. Paul Corbin. The works are situated at Chedde, Haute Savoie, close to Chamounix, and almost under the shadow of Mount Blanc.

The patents of M. Paul Corbin, above referred to, were applied for in 1892 and 1894, and were based on experiments made at M. Corbin's cellulose factory at Lancey, Isere. They relate to the forms and details of electrodes and vats for the electrolytic decompositions of solutions of the alkali metal chlorides. The above named company was formed early in 1895, for development and utilization of the waters of the Arve and for industrial operation of the Corbin patents, and the building of the works at Chedde was commenced in June of that year. Six hundred men were employed upon the various hydraulic, engineering and building works required, and in 13 months from the date of commencement the factory was ready for manufacturing operations. It has been in continuous operation since July, 1896, and is now producing chlorate at the rate of 3,000 tons per annum, in addition to other chemical products, of which calcium carbide is the chief.

ELECTROLYTIC CHLORATE—PIPE LINES ON BRIDGE.

The power used in the factory is obtained from the River Arve, the most important hydraulic engineering works being situated at the point where the valley of Chamounix joins that of Sallanches. A dam with the usual flood-gates and sluices has been built at this point, just below the bridge of Servoz. From here the water is led by a tunnel 698 metres in length to the foot of the ravine of Chatelard, where the first fall occurs. The power generated at this spot is to be utilized for the electric railway which is to unite Chamounix and Fayet. The water is then led through the valley of Chatelard in two steel pipe lines (each 1.40 metres in diameter), and enters a second tunnel 700 metres in length, from this it emerges at a point 140 metres above the works at Chedde, and is carried down to the turbine house, in two steel pipe lines, 600 metres in length, each 1.40 metres in diameter, and of metal 15 millimetres thick at the lower end of the line. A bridge over the river is necessary to carry the two pipe lines into the turbine house. (See illustration.) The total length of galleries and tunnels carrying the waters of the Arve to the factory is 1,790 metres. The sectional area varies from 5 to 30 square metres, while the flow of the water varies between five and eight cubic metres per second. The power available is said to be 12,000 horse-power; the maximum of course being in Spring when the River Arve is in flood. At present only a portion of this total is utilized in the works.

The turbine house is a narrow building, 120 metres in length. It contains 12 vertically placed turbines, each of 1,000 horse-power. The dynamo house adjoins and is of the same length; it contains 12 direct-current Oerlikon dynamos, each directly coupled to one of the 1,000-horse-power turbines; and each capable of delivering 830 electrical horse-power. The total area covered by the buildings of the Chedde Works is 13,000 square metres. The chief building is that containing the decomposing vats, which is 130 metres long, 60 metres broad, and 21.5 metres in height. The vats in which the solution of potassium chloride is submitted to electrolysis are built of cement,* and have the form shown in Fig. 1, which represents a sectional elevation of the vat. The chief features of this form of decomposing cell are a large number of insulated intermediate electrodes—second electrodes—and the provision of external cement channels round the vats, for carrying off the electrolyzed solution, which flows over its sides.

The secondary electrodes are all of thin platinum foil, held in ebonite or other non conducting frames, of exceptional width. By use of these wide frames, M. Corbin holds that he has overcome the losses due to lateral dispersion of the electric current, which usually occur when attempts are made to utilize secondary electrodes in industrial operations. The secondary electrodes are entirely submerged in the electrolyte, and are held in position by two longitudinal guide bars, running parallel to one another in the vat, bearing grooves for reception of the ebonite frames. The distance separating the secondary electrodes is only 12 to 15 millimetres. The two terminal electrodes are alone connected with the external current conductors. They are formed of thick plates of metal, covered with platinum foil, and fixed over the openings in the two end walls of the vats. M. Corbin lays great stress upon the importance of having both secondary and primary electrodes mathematically in line, and exactly similar in form and surface area. The flow of the electrolyte within the vat is indicated by the arrows in Fig. 1. The current on passing through such a cell as this is confined to the line of the electrodes, by reason of the wide ebonite frames encircling them, and performs electrolytic work between each pair of electrodes. In this case, when a solution of potassium chloride forms the electrolyte, chlorine is liberated at the anode surface, and potassium hydrate at the cathode surface of the platinum walls forming each separate cell; and these unite to produce potassium chlorate or potassium hypo-chlorate, according to the temperature at which the reaction occurs. The remaining buildings of the Chedde factory comprise the usual recrystallizing, drying, grinding and packing departments, common to all chlorate factories, whether using the old or new process of manufacture.

When an aqueous solution of sodium or potassium chloride is electrolyzed by means of insoluble electrodes, without the interception of a diaphragm to prevent the reaction of the chlorine and the sodium or potassium hydrate, two reactions may occur. If the electrolyte is kept cool (under 20 degrees centigrade) a hypo-chlorite will be formed according to the equation marked (1) below. If, on the other hand, the solution of chloride be warm or be made hot by use of a high current density, the chemical change represented by equation (2) is assumed to occur, and chlorate is produced.

$$(1)\ 6\ Cl + 6\ KOH = 3\ KClO_2 + 3\ KCl + 3\ HO \text{ (cold)}$$

$$(2)\ 6\ Cl + 6\ KOH = KClO_2 + 5\ KCl + 3\ HO \text{ (hot)}$$

It was formerly assumed by chemists that these two reactions represented the secondary changes occurring in the electrolytic cell under the conditions described above; but recent researches by Bishoff & Foerster, by Oettel, by Winteler, and by Merle have thrown doubt upon this older theory, and there is now strong evidence that the formation of hypochlorite and chlorate in the electrolytic cell is less simple than that described above. The work of Oettel upon this subject is especially valuable, and every manufacturer of chlorate by the electrolytic method ought to be thoroughly conversant with the details and results of this chemist's laboratory investigations. Briefly summarized, his researches prove that chlorate is formed partly by oxidation of the hypo-chlorite in the cell, and partly by the direct union of chlorine and oxygen at the surface of the anode. In neutral solutions of the chloride, the first reaction predomi-

* The description of the decomposing vats used at Chedde is based on that given in French patents 226,257 of 1892, and 238,612 of 1894. It is possible that modifications of these forms have been introduced as the result of practical work.

nates; in strongly alkline solutions the second. Wohlwill has also investigated this subject, and has obtained results which proves that chlorates are formed by reactions between (Cl O) and (O H) "ions."

Whether the intermediate changes be simple or complex, the final result is the same, and six atoms of free chlorine can not yield more than one molecule of potassium chlorate. As five atoms of chlorine revert to the form of potassium chloride, the general reader may be disposed to regard the process as a wasteful one. It is, however, the only one by which chlorates can be made cheaply upon an industrial scale. Exactly the same loss of chlorine occurs in the older method of manufacture, which only differs from the electrolytic method in the manner of obtaining free chlorine, and in the use of calcium hydrate in place of sodium or potassium hydrate, as the absorbing medium.

All the electrolytic processes for the manufacture of chlorate are based on this fundamental reaction, and it is interesting to note that this method of producing chlorate in an electro-

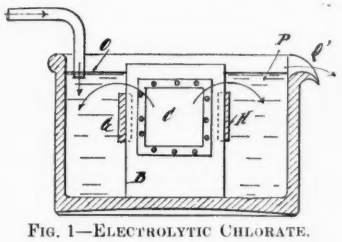


FIG. 1—ELECTROLYTIC CHLORATE.

lytic cell was first noted by Stadion in the year 1816, and was patented by Charles Watt in 1851. Later patent claims, therefore, are valid only, in relation to novel details of the apparatus by which the process is to be carried out on a commercial scale.

The writer is not able to give any figures for the yield of chlorate per electric horse-power-hour, or for the cost of chlorate, by the Corbin process at Chedde, since no data of this kind have yet been published by M. Corbin, and direct application has failed to elicit any figures. The following estimates are, therefore, general ones; but they are based on actual production figures for the chemical and electrolytic processes, and are in consequence worthy of careful consideration by all interested in the future of this new industry.

The low current efficiency is due to several causes, chief of which is the reducing action of the hydrogen liberated at the cathode upon the oxy-compounds of chlorine present in the electrolyte. Gall and Montlaur seek to minimize this action by encasing the cathode in asbestos bags—open above; while Blumenberg seeks to avoid this cause or loss by use of diaphragms and by conduct of the secondary reactions outside the decomposing cell. The low energy-efficiency of the electrolytic process is due to the high current-density purposely used to maintain the electrolyte at the required temperature. This involves the use of a high electromotive force, much above that theoretically required to decompose the sodium or potassium chloride.

Recently considerable attention has been given to the improvements in the yield of chlorate per kilowatt hour which can be obtained when an alkaline carbonate, or when calcium hydrate is present in the cell; and these additions have been made the subject matter of patents by Schuckert & Cie, by Kellner and by Spilker and Loewe. Since Charles Watt, in 1851, noted the advantage of adding alkalies to the electrolyte, and since Oettel has fully investigated the effects of adding calcium hydrate and has published his results, the validity of these patent claims is doubtful.

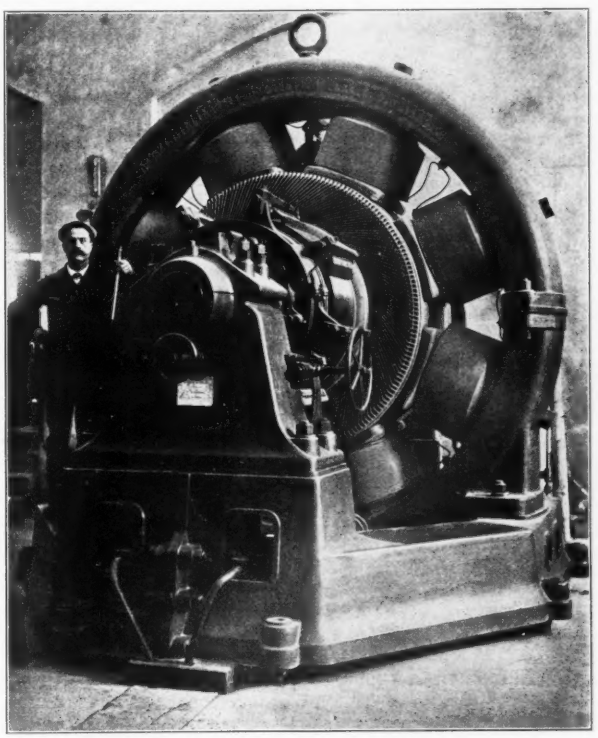
Though the exact nature of the chemical changes which result from the presence of alkaline carbonate, or calcium hydrate in the cell, is not definitely settled, there is no doubt that an increase yield follows their addition; and it is probable that the use of calcium hydrate or of potassium carbonate in the decomposing cells is now general in all electrolytic chlorate works. Oettel found that when using calcium chloride solution as the electrolyte he could obtain current efficiencies as high as 83.3 per cent; but his attempt to work this process as a continuous one, and to regenerate calcium chloride, failed, owing to physical changes in the calcium hydrate separated at the cathode. Foerster and Bischoff attributed the better yield obtained when calcium hydrate is present in the electrolyte, to a film of calcium hydrate which forms at the cathode. Oettel likewise considers that such a film is formed, but he inclines to the opinion that it contains calcium oxy-chloride. Foerster and Bischoff recommend a temperature of 50 degrees centigrade, in order to obtain the best results.

As regards the cost of electrolytic chlorate, the writer gives the following estimate, based on an output of 800 tons per annum, and a cost of electrical energy of one-fifth cent per electric horse-power-hour. This latter is, of course, exceeded, where very heavy expenditure has been necessitated upon hydraulic works; but for such installations as those at St. Michael and at Chedde, he is inclined to think, it is not too low. The power plant is 3,000 horse-power, equivalent to 2,400 electric horse-power. The annual output 800 tons.

Table I.—Efficiencies of Electrolytic Chloral Processes.

Process.	Volts Used.	Grammes $KClO_3$ Obtained.		Efficiency Per Cent.		Basis of Calculations.
		Per Amp. Hr.	Per Kw. Hr.	Current.	Energy.	
Gall and Montlaur	5	.273	54.6	35	18	Annual output at Valorbes.
Gall and Montlaur	5	.347	69 4	45	22	Lunge's figures.
Oettel's Experimental	3.3	.396	119.0	52	39	.....
Blumenberg	?	?	235.0*	?	77	Dunlap's figures.
Theoretical	2.5	.762	305.0	100	100	.....

*These figures are certainly untrustworthy, since even Oettel, in his laboratory investigations, rarely obtained an energy efficiency of 50 per cent.



ELECTROLYTIC CHLORATE ONE OF THE 830-HORSE-POWER DYNAMOS.

Capital expenditure:	
Water-power plant	$49,920
Electrical plant	65,280
Total	$115,200
Working Expenses:	
Power, 3,000 horse-power @ 1-5 cent per electric horse-power-hour	$47,520
Depreciation (electrical plant), 10 per cent	6,528
Potassium Chloride, 606 tons, $38.4 per ton	23,270
Packages at $4.80 per ton	3,840
Wages, 12 men (four at $9.60 per week; four, $7.20; four, $6)	4,742
Repairs, renewals, fuel	4,800
Management and office charges	4,800
Taxes, brokerage, etc	4,800
Total annual expenditures	$100,300

These estimates are based on European rates of wages and freights. On an output of 800 tons this equals a net cost of 5.59 cents per pound. From figures in the writer's possession, relating to the older chemical method, he believes that the cost by the latter process is about the same. The above estimate is, however, based on a very low-energy efficiency (18.8 per cent), and it is therefore evident that the electrolytic process is in the more favorable position, apart altogether from questions of simplicity and cleanliness.

The price of chlorate in the early part of 1898 had fallen in England to six cents per pound, and the margin of profit to the manufacturers by either process was extremely narrow. An arrangement has, however, been made between the European producers, and since the Autumn of 1898 the price of chlorate of potash in England has advanced to 7.5 cents per pound. The price, of course, rules higher in America, on account of the duty, and the prospects of profitable manufacture are correspondingly increased.

The writer, in conclusion, must express his thanks to M. Paul Corbin for the photographs of the factory at Chedde, which have been reproduced as illustrations, and also for many of the details concerning the hydraulic works given in the earlier portion of this article.

Success in Advertising.

Advertising will not work miracles. It will not make a badly managed business pay. It is not a substitute for careful buying, cash discounts, wise arrangements, or effective organization. You must have the right article, purchased or manufactured to the best advantage, handled in the best way, offered at the right price, or advertising will prove a useless expense. Organize your business so as to secure for the public the best that is going for the money; buy in the best market; get your cash discounts and all other advantages, and—advertise!—*Des Moines News.*

Development of the Independent Telephone Business.*

As attorney for the United States Telephone Company, of Cleveland, Ohio, which company is building first-class long-distance toll-lines to connect all of the independent telephone exchanges in Ohio, I have had occasion during the past few months to try to ascertain the statistics relating to the independent exchanges and toll-line systems built and building in my own state. It has been almost impossible to get them, even with most careful observation. Exchanges are built and put into operation in small towns, and connected with the outside world before their neighbors in adjacent counties are aware of the fact. Toll-lines are building, and, like the Kansas pumpkin vine, in one night grow so far that the end can not be found the next day.

The New York *Sun* publishes an article in which the growth of the telephone business in this country since 1884 was shown in figures given by the reports of the Bell company. The article concludes as follows:

"It must be remembered that the independent telephone movement, which has been growing rapidly from the expiration of the fundamental Bell patents six years ago, has assumed important proportions, and that its promoters and supporters have established in the neighborhood of 3,000 exchanges throughout the country. Naturally many of these are in small places where the Bell company's rates have proved an insurmountable barrier, but others are in towns where exchanges have been in operation. The low rates of the anti-Bell companies have greatly stimulated the business and placed the service within the reach of many who could not afford Bell prices. In spite of the reduction of prices the character of the service has been improved, as competition has made it necessary for the Bell company to use inventions and improvements that otherwise have been buried."

Items and extracts like the foregoing might be multiplied almost indefinitely, and yet they scarcely give an adequate conception of the marvelous development of the independent telephone movement and business in our country.

It is altogether probable that the statement credited to the New York *Sun* is not too high. It is corroborated by the information given by the Indianapolis *Sentinel* that there are more than 150 independent exchanges in the Hoosier State. There are about the same number in Ohio, and some 50 more exchanges in that state are now in different stages of promotion and completion. It is certain that pretty much every city and town in the Buckeye State will have an independent telephone exchange with ample long-distance connections within the ensuing year. The Bell company in Ohio, represented by about a half-dozen subordinate or licensee companies, has not 100 exchanges in that state.

The independents, where they have completed exchanges in Ohio, are operating more than 21,000 telephones as compared with but little more than 4,000 used by the Bell company and its licensees in the same town and counties, and their toll service is almost proportionately larger than the Bell company's.

This growth has come notwithstanding the claims of the opposition company, that the independents could not make good telephones and switchboards and could not operate them successfully even if they had first-class apparatus. These claims of the opposition company have been proved untrue. There are to-day in this country, as you all know, many manufacturing concerns turning out apparatus for the independent telephone users which is equal in every respect with that turned out by the manufacturers for the American Bell. No better evidence of this fact is needed than is shown by the figures of the number of telephones used by the old and new companies in the same territory.

It has been my good fortune within the last few days to visit St. Louis and Indianapolis, and at a more remote period Detroit, Grand Rapids, Knoxville, Sioux City, Ft. Wayne, Sandusky and numerous other large cities in which independent telephone exchanges are now in successful operation in competition with the Bell company. In every single instance the independents have more telephones than the old company, and in a number of them three times as many. These exchanges represent the apparatus of many different manufacturers, and are working against the most severe and active competition. In every single instance, from my personal observation, these exchanges are giving most satisfactory service, and in one of the cities referred to the largest single switchboard now in operation in the United States is daily answering more calls per drop than any switchboard in North America.

The tendency has been toward cheaper service and better construction. This tendency toward cheaper service has gone far enough, and care should be taken that rates are not fixed so low that the plant can not be maintained in first-class condition from its earnings, in addition to a reasonable profit through all the future years. The cities and towns above specifically referred to are but a drop in the bucket, and the different manufacturers of Independent telephones each have their apparatus in successful operation in hundreds of towns and cities other than those above mentioned.

The independent telephone movement acquired its first great impetus in the middle western states. The greatest development has, up to this time, taken place in those states, notably Iowa, Wisconsin, Michigan, Missouri, Illinois, Indiana and Ohio, while Pennsylvania, Kentucky, West Virginia, Minnesota, Kansas, Nebraska and the Dakotas have followed but shortly in the rear. But within the past two years especially, the movement has extended until it embraces all sections of the country, and to-day from Portland to Atlanta, from Boston to San Francisco, from Minneapolis to Galveston, and all the intervening country, independent exchanges and toll-lines are building, new money and new brains are becoming interested, new patrons are served and new fields developed. This is not idle talk, as the following will illustrate: On the Pacific coast, Portland, Seattle and San Francisco are building; Minneapolis and St. Paul are building; New Orleans, Galveston and Austin are in different stages of completion. Memphis and Atlanta have recently organized strong companies which will prosecute the work to a successful finish at a very early day. I am informed that contracts for the Pittsburgh switchboard and telephone have been let; Baltimore and Boston, the latter the home of the American Bell Telephone Company, are building; that Philadelphia and New York will begin actual construction within the next 60 days. Cleveland will give service to more than 6,000 telephones before the close of the present year. More than 200 men are at work on the subway in Columbus, Ohio, which will be in full service within eight months. Dayton and Springfield, Portsmouth and Marietta, are at it; Indianapolis, St. Louis, Grand Rapids, Detroit, Dubuque, Sioux City, Cedar Rapids, Fort Wayne, Newark and Trenton, N. J., Worcester, Mass., and Richmond, Va., are among the larger towns and cities which are now giving cheaper and better telephone service through independent plants, than has ever yet been given by the old company.

That the business has been safely and profitably conducted is proven by the fact that there have been fewer failures of independent telephone companies in the United States, since they came into existence, than there have been of national banks—a showing which no other business with such phenomenal growth has ever shown.

One thing which I should have stated more clearly is the fact that in almost every state in the Union, most notably, perhaps, in the Middle West before referred to, strong combinations are being formed, with the sole purpose of building first-class toll-lines within their respective states, and with an understanding or arrangement for the interchange of business with like companies in adjacent states. This work has already progressed until many thousands of miles of this kind of construction are now built, connecting the local exchanges and toll-line systems with the outside world, and the work is rapidly progressing.

With this development must come, and through this association can and should come, a harmonious determination or solution as to the charges for service, not only local, but long distance. I am afraid that we do not always realize the fact that we are dependent to a great extent upon each other.

Another phase of the situation which has been briefly referred to is the character of construction. The growth toward better apparatus and better construction has been quite satisfactory, especially in the last two years. The time was when independent companies built carelessly, giving little attention to excellence in construction or superiority of apparatus. Other papers have given you valuable information in this department. I find from listening to the statements of those connected with the larger new companies and of those who have been longest in the independent field, as well as from personal observation, that very radical improvements have been made of late in the character of construction and results attained. Brains, inventive genius have found a field among the independents, and the patent office has shown greater activity in this department of electrical inventions during the past four years than in all the preceding 20 years. Manufacturers are striving in every way to better the apparatus turned out by them. Operators are not slow to avail themselves of these improvements. Builders are using the best and looking for better.

In my own state a very important development has begun among the farmers. It is true that many of the small towns and villages are now successfully supporting telephone exchanges, and the farmers in the adjacent rural districts are getting service at a price within their means, and are insisting upon telephone facilities. Thousands are already connected with exchanges, and tens of thousands more are applying for service in the more thickly settled agricultural regions of our country.

The telephone will soon be as proportionately general in the country as it now is in the towns, and combined with the electric railway will bring the satisfying conveniences of life to the homes of all, and will have no little influence in deterring many from leaving the farm to seek the comforts and conveniences of urban life because they do not enjoy the isolation of the country.

I heard one of our number remark not long ago that, in his opinion, we were but at the threshold of the use of the telephone. That may seem an exaggeration, but when within two, three or four short years communities have increased their telephone service from 2 to 10 times, and there seems no cessation of the development, such statement can not be considered inaccurate.

The telephone should be within reach of all, and the development which I have but hinted at in the foregoing will progress in geometric ratio, and when future annual conventions of this association shall meet, while they will respect the attainments of the first five years of independent effort, it will be said that we were but digging the trenches and building the foundations for the then superstucture. Let us see to it that those foundations which we are now working on are ample in breadth and strength to support the whole future development, and that in after years we may say that we have planned wisely and executed well.

* By H. D. Critchfield, before the Telephone Convention, Chicago, June 27.

Telephone News .....and Comment

There are now over 450 private branch telephone exchanges of various sizes in operation in New York city.

The New York & Pennsylvania Telephone Company will build a new exchange in Erie, Pa., this Summer. J. V. Graff, of Elmira, is the new manager.

regular quarterly dividend of three per cent and one and one-half per cent extra, payable July 15 to stock of record June 30. Books closed at close of business July 1 and reopen July 15.

At the annual meeting of the stockholders of the Erie Telegraph and Telephone Company, J. C. Burke, Lowell, Mass.; A. B. Chandler, New York, and David S. Greenough, of Boston, succeed H. D. W. Burt, A. S. Adams and C. E. Adams in the board of directors.

Arthur Overshiner, general manager of the Marion Independent Telephone Company, has secured a franchise for the use of the highways in Madison County for telephone purposes, and the Marion lines will be extended to Anderson and Indianapolis. A franchise has also been secured for a line to Bluffton.

It is asserted that within a short time the Southern Massachusetts Telephone Company, operating all the telephone systems of Massachusetts south of Norfolk County, is likely to be absorbed by the New England Telephone and Telegraph Company, operating all the Bell systems of New England, except in Rhode Island and Connecticut.

The Central Union Telephone Company, of Greenfield, Ind., not being able to buy the local exchange here, for which it offered $10,000, is circulating a petition to secure subscribers to a new telephone exchange, which will connect with the Central Union lines at Indianapolis and other Indiana cities and its long-distance connections. A telephone war here is said to be certain.

President Chas. J. Glidden, of the Erie telephone system, which operates under the Bell patents 82,000 subscribers in eight states, confirms to the ELECTRICAL REVIEW his statement recently published in the New York *Tribune*, that he would pay $1,000,000 for a telephone repeater or quadruplex that, used in connection with the telephone, would produce, telephonically speaking, the same results that the telegraph repeater and quadruplex do to-day in the workings of the telegraph. The offer is creating great interest among electrical inventors.

The Chicago Telephone Company is to treble its capital stock, and put in a number of permanent improvements that will greatly benefit the service and lessen the expense.

The board of directors has decided to recommend to the stockholders at the next annual meeting that the capital stock be increased from $5,000,000 to $15,000,000. This proposition will doubtless be adopted, and the new stock will be offered to the present stockholders at par.

The company is erecting an addition to its building on Franklin street. When completed it will be an eight-story building all occupied by the company.

SOME OF THE DELEGATES TO THE INDEPENDENT TELEPHONE ASSOCIATION'S CONVENTION IN CHICAGO, JUNE 27TH AND 28TH.

The Western Union company has completed arrangements to construct three lines between Denver and Omaha, two from Denver to Salt Lake, and two from Denver to Cripple Creek and Trinidad.

Bibberstaff & Atkins have secured the contract for building the new exchange to be erected by the Michigan Telephone Company at Kalamazoo, Mich. The building will cost in the neighborhood of $20,000.

The directors of the American Bell Telephone Company have declared a

The Leffel Engines.

The accompanying illustrations represent the Class "B" standard center-crank automatic cut-off engines being put on the market by James Leffel & Company, Springfield, Ohio. They are intended to meet the demand for a thoroughly good, simple and easily cared for line of automatic engines in the smaller sizes up to 50 horse-power, that will prove durable and economical in operation. Fig. 1 is a view showing the steam chest side, while Fig. 2 illustrates the governor in the band flywheel.

The main frame or bed is of substantial proportions, and of a design affording extra strength and stiffness. The cylinder and steam chest are of the overhanging type, cast together and firmly bolted to the bed. The cross-head guides are a part of the bed, bored out, and have very generous surface. The cross head is of improved mechanical design, having its pin about mid-center, and provided with gun-metal wedge-shaped shoes above and below, arranged for convenient adjustment. The manner of fitting the cross-head pin enables easily keeping it absolutely tight at all times. The piston rod is of steel, and turned to a tight force fit in the piston, with suitable shoulder, against which the piston is forced on the rod, and the end of the latter is then securely riveted over, tightly and firmly holding the piston in place.

The connecting rod is provided with extra heavy brass boxes at each end, easily adjustable for taking up wear and keeping distance between centers the same at all times. The main shaft is extra large and strong, forged in one solid piece, from the best quality hammered iron or steel, and is provided with suitable counter balance disks, securely attached. The rectangular form of skeleton slide valve is used, balanced by being fitted with a pressure-relieving plate on the back between the valve and the steam chest lid, and is arranged to afford necessary relief in case of water in the cylinder, and is also made adjustable for wear. This gives a simple, efficient and well-balanced valve, that is easily understood, and no more trouble to care for than the ordinary type of plain slide valve. A simple and convenient device (not shown in the illustrations) is provided for draining the cylinder. It is operated by one lever and has an outlet from each cylinder cock suitably connected to the exhaust pipe. These engines are equipped with the Rite's governing system, which is extremely simple, as shown in Fig. 2. The governor consists of one piece, comprising the arms and weights, with one spring connection, and is pivoted on one hardened steel pin. There is nothing complicated about it. This governor, with the balanced valve used, affords a regulation that is claimed to be practically perfect, speed being constant, and the same with the engine loaded or running empty. The manufacturers will be pleased to furnish prospective users with any additional information desired regarding these engines.

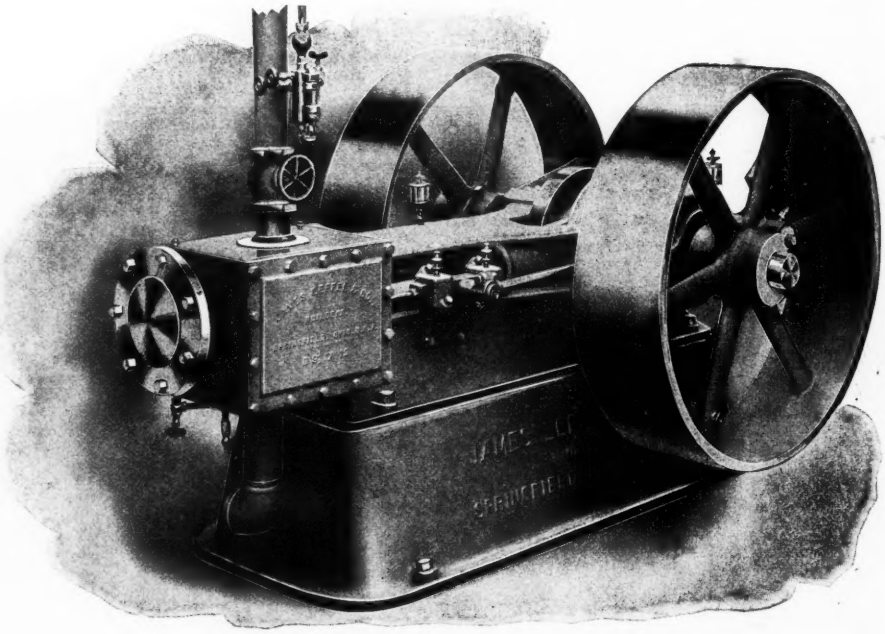


FIG. 1.—STEAM CHEST SIDE OF LEFFEL ENGINE.

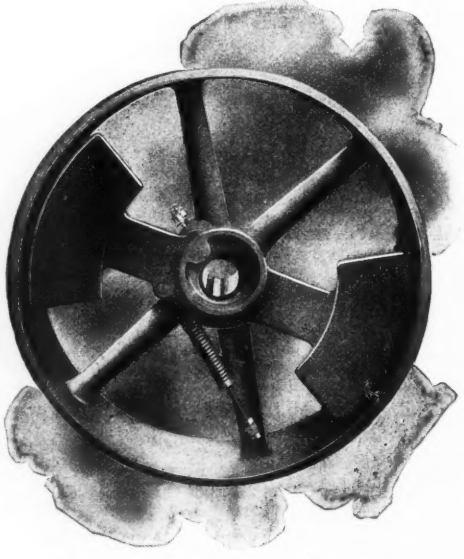


FIG. 2.—GOVERNOR IN BAND FLYWHEEL OF LEFFEL ENGINE.

Electric Installation for a Private House.

The Westinghouse Electric and Manufacturing Company have recently completed an interesting electrical installation at the Summer cottage of Mr. C. M. Schwab, at Loretto, Pa. A quaint town is Loretto, 20 miles from Altoona, 2,300 feet above sea level. Although celebrating its centennial last month, it numbers only 200 to 300 souls. Old-fashioned hardly describes its lighting arrangements for gas is unknown, and even oil lamps are used sparingly, for many prefer to make their own tallow dips. Mr. Schwab's electric lighting is the one topic for gossip.

In a separate engine house, 325 feet from the house, a Westinghouse steam engine of 15 horse-power is direct-connected to a Westinghouse engine type, direct-current, 150-volt generator. This unit supplies electric current either direct to the lighting circuit, or to a storage battery of 60 cells. The lighting service consists of 187 incandescent lamps scattered through the house, stables and driveway, but when required extra lamps can be used for any special service, such as for tents on the lawn.

The storage battery has a capacity of 80 amperes for three hours, 40 amperes for eight hours, or 20 amperes for 16 hours. Usually the steam engine is shut down early in the evening, and the storage battery supplies current until the following morning.

A very ingenious arrangement has been effected by which the generator and battery are operated in multiple. By means of a rheostat the electromotive force of the generator can be reduced to 110 volts to feed the lighting circuit direct. In case the demand for current exceeds the supply from the generator, the battery can be run in multiple with the generator to feed the circuit.

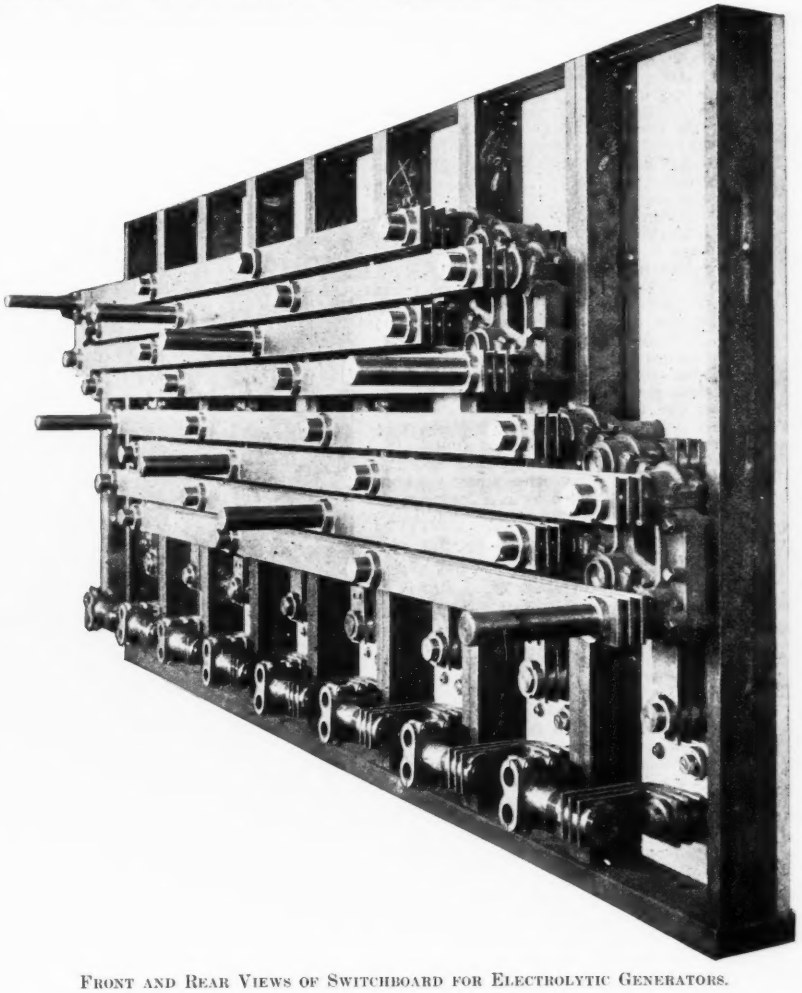
Another device upon the switchboard is a rheostat for controlling the charging and discharging of the battery. The potential from the generator is 150 volts, and the supply to the lighting system is 110 volts. In charging the battery, the rheostat is put in position to connect all the 60 cells with the generator. In discharging the battery into the lighting circuit, the rheostat is placed so as to cut in 46 cells only, which are in series, thus reducing the potential to the required pressure. Should the potential drop to 100 volts, a movement of the rheostat will cut into the lighting circuit a sufficient number of the remaining 14 cells to raise the pressure to 110 volts.

The switchboard is also provided with two circuit breakers, one for overload and the other for underload. Should a short circuit occur in the line, the overload circuit breaker automatically flies out and cuts off the connection with the storage battery. In case the engine shuts down and the voltage or current from the generator drops below the potential of the storage battery, the underload circuit breaker automatically cuts off the battery from the generator and prevents any loss of current, but the storage battery continues to feed the lighting circuit.

In Mr. Schwab's park, 500 feet distant from the house, an iron plate crosses the roadway, which works an electric contact through a three-point switch. The wheels of a vehicle crossing this plate turn the switch, causing the entrance gate to open automatically and the electric lights on the drive to be turned on. An outgoing vehicle reverses this process, turning out the lights and closing the entrance gate. A switch on the veranda turns the lights either on or off.

Switchboards for Electrolytic Work.

The illustrations herewith show the front and back of a switchboard for four 270-kilowatt electrolytic generators, each giving 3,600 amperes at 75 volts direct current. The board consists of beveled white marble panels, firmly secured to a solid structural-iron framework, and is seven feet six inches high by ten feet wide. The eight single-pole switches on it are each of 3,600 amperes capacity. These are operated by means of the hand-wheels shown at the lower part of the front of the board. The connections are all made on the back of the board by means of heavy copper bus-bars, screwed to threaded instrument studs extending through the marble. The work upon this board in its solid and massive character reflects much credit upon its maker, the Westinghouse Electric and Manufacturing Company, Pittsburgh, which is now constructing a large amount of apparatus for electrolytic work.



FRONT AND REAR VIEWS OF SWITCHBOARD FOR ELECTROLYTIC GENERATORS.

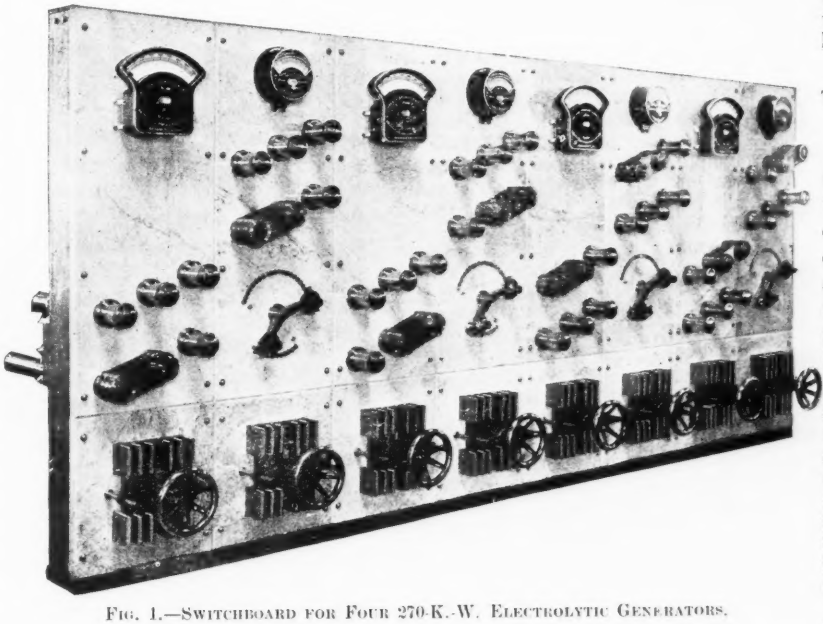


FIG. 1.—SWITCHBOARD FOR FOUR 270-K.-W. ELECTROLYTIC GENERATORS.

Human Rays.

Mr. Ottokar Hofmann has communicated to the *Engineering and Mining Journal* a description of an extraordinary series of observations, tending, in his opinion, to show that the human body is a source of some sort of invisible radiation, which affects photographic plates. Briefly stated, the author's method consisted of exposing a plate, while immersed in a bath of developer and in total darkness, to the action of the hand or finger-tips held at a short distance from it. By various methods he excluded the possibility of effects arising from temperature differences, or the emission of minute quantities of hydrogen-sulphide by the skin. The observed effects were shadowy black spots on the plates, corresponding to the finger-tips, etc., even when these were presented to the back or glass side of the plates. The author concludes that these emanations are stopped by metals, but can pass through glass, hard rubber, developing solution, air, etc. No effect is noted if the plate is first exposed to the emanations and then developed.

This opens a very interesting field of inquiry. It has been already noticed by X-ray operators that the close approach of the body, especially thick and fleshy parts, to the plate produces an effect upon it, but, in a sense, the reverse of that noted above. Such plates appear to be "slowed" in parts nearest the body. The effect has been attributed to moisture, temperature, etc., and can be eliminated by interposing a wooden board between the body and the plate. The subject is one that seems to promise interesting experimental developments.

Worcester & Webster Street Railway Company.

The Westinghouse Electric and Manufacturing Company are providing an electric equipment for the new railroad now under construction by the Worcester & Webster Street Railway Company. The road connects Worcester, Mass., with Auburn, Oxford and Webster, a distance of 17 miles, passing through one of the most picturesque routes in New England. The line terminates at Lake Chaubunagungamuag, the prettiest inland water in Massachusetts, much frequented by excursion and pleasure parties. The power-house is centrally placed, and will contain two 250-kilowatt Westinghouse "engine-type" generators, direct connected to steam engines, to work at 120 revolutions per minute. Great care is being taken in constructing the track. The rails are specially heavy, the ties are seven feet long and the roadbed is ballasted with gravel. The roadbed is being built on the exact lines of steam railroads, by elevating the curves and adapting it for rapid transit traffic. The cars are to be of extra size, having a seating capacity of 36 people, and capable of carrying 90 passengers. Each car will be provided with double trucks, and two 50-horse-power Westinghouse high-speed motors. The 100 horse-power applied to each car will give an average speed of 35 miles an hour. Westinghouse air-brakes will be attached to the cars, together with compressed air whistles, telephones and all the latest appliances.

The Siemens & Halske Electric Company of America.

The Siemens & Halske Electric Company, Chicago, of which Mr. Chas. S. Knight, one of the best known men in electric manufacturing, is the active executive, announce that the rumor that the company is to manufacture electromobiles only is erroneous. The company is manufacturing all kinds of high-grade electrical apparatus for lighting and power, and they are taking orders for and manufacturing all types of apparatus. In fact, it is safe to say, the Siemens & Halske company is in the field to take orders for all kinds of electrical apparatus.

The large factory at Chicago is crowded with work, but it is being turned out so rapidly that new orders receive the best of attention.

TWO HOURS SAVED BY THE SARATOGA LIMITED.

ELECTRICITY TO AID IN FURTHER SAVING OF TIME.

The new "Saratoga Limited," on the New York Central, was placed in commission June 24, and the initial trip very successfully made. The distance between New York and Saratoga Springs is 180 miles, and the time heretofore has been about five and one-half hours. It is now made in three and one-half hours, with one stop at Albany. On the occasion of the inauguration of the service, General Passenger Agent George H. Daniels, of the New York Central, invited a party of 40 newspaper friends to be his guests. The beautiful modern train, just completed at a cost of over $100,000 by the Wagner Palace Car Company, arrived at Saratoga Saturday, June 24, on time, and received an enthusiastic welcome from the citizens of that famous and beautiful resort. Probably the greatest crowd was at the depot to welcome the train that ever assembled in that little city. A number of the leading hotels of Saratoga gave open house to the visitors from New York. Among these were the United States, Grand Union, American-Adelphi, Windsor and Worden, and the proprietors of each of these hotels were particularly kind to the "strangers within their gates," as well as the managers of the various springs. Col. W. S. Powell, of the Arondack, and Frank H. Hathorn, of the Hathorn springs, were especially kind in their attentions; in fact, every person in Saratoga seemed alive to the occasion, and contributed in every way in his power to add to the pleasure of the guests.

Saturday evening, Hon. John Foley, president of the village, delivered an address of welcome at the United States Hotel, speaking at some length on the importance to Saratoga of this new fast train which the enterprise of the New York Central had started for the benefit of its public. Mr. George H. Daniels, general passenger agent of the road, responded in an interesting address in which he stated that he expected to see in the not far distant future electricity used as the motive power on railroads, and time still further reduced between "Saratoga the Beautiful" and New York city, until the trip would be no more burdensome than from the heart of the metropolis to Coney Island. The response on behalf of the newspaper guests was delivered by Hon. William Berri, publisher of the Brooklyn *Standard-Union*, whose humorous and congratulatory remarks were happily received. Other addresses were delivered.

The following resolution was unanimously adopted on the return trip:

The initial trip of the new Saratoga Limited, of the New York Central Railroad, from New York city to Saratoga Springs and return, June 24-26, 1899, having been of such preeminent success and pleasure, and so rapid and exact in time, deserves this acknowledgment from us, the guests of the occasion. The enjoyable and remarkable journey we have had, and the hospitalities we have received from the citizens of Saratoga Springs, justify a formal expression of our appreciation.

We especially desire to return our most cordial thanks to General Passenger Agent George H. Daniels, of the New York Central; General Passenger Agent J. W. Burdick, of the Delaware & Hudson; Superintendent C. R. Wager, of the Wagner Palace Car Company, and to Mr. Daniels's lieutenants, F. J. Wolfe, J. E. Root and C. J. Laing, for the personal interest manifested in making the trip one of the most delightful experiences of our lives. Our thanks are also due to the president of the village, Hon John Foley, and to the proprietors of the Grand Union, the United States, the Windsor, the American-Adelphi and the Worden hotels for courtesies and comforts so agreeably extended to us during our all too brief sojourn in "Saratoga the Beautiful."

The poet of the occasion, Mr. W. J. Lampton, of the New York *Sun*, spontaneously evolved the following, which was received with enthusiastic approval:

Wherever we go, wherever we be,
On mountain, river, lake or sea,
In Heaven, even, we shall feel
That nothing made can quite reveal
Such dear delight as Daniels finds
For weary bodies, weary minds;
And on a little trip like this
Loads all his guests chock full of bliss.

The American Telephone and Telegraph Company kindly placed its long-distance service at the disposal of Mr. Daniels and his guests from Saturday night until Monday morning. This service was greatly appreciated and extensively used by the railroad and newspaper men present. General Manager Hawley, of the Hudson River Telephone Company, came up from Albany to see that all the details were properly arranged.

General Passenger Agent J. W. Burdick, of the Delaware & Hudson Railroad, and Superintendent C. R. Wager, of the Wagner Palace Car Company, accompanied Mr. Daniels on the trip, and with him were the recipients of many compliments and congratulations over the success of the initial trip of the new "Saratoga Limited."

Among the gentlemen present were: John A. Sleicher, *Leslie's Weekly;* James Arthur Seavey, New York *Sun;* C. M. Palmer, New York *Journal;* Hilary Bell, New York *Press;* W. A. Johnston, New York *Herald;* H. D. Vought, New York *Commercial;* Louis Wiley, New York *Times;* H. F. Gunnison, Brooklyn *Eagle;* William Berri, Brooklyn *Standard-Union;* S. W. Taylor, *Rider and Driver;* Charles W. Price, ELECTRICAL REVIEW; H. G. Paine, *Harper's Weekly;* R. C. Alexander, *Mail and Express;* Arthur A. Parks, *Evening Telegram;* William J. Boies, *Evening Post;* R. B. McIntyre, *Evening News;* Stephen MacKenna, *The Criterion;* W. J. Lampton and R. K. Munkittrick, special writers, and Frank W. Mack, of the Associated Press.

THE INDEPENDENT TELEPHONE CONVENTION.

(*Continued from page 7.*)

farmers' line very satisfactorily for $55 or $60 a mile. We would like to get hold of the gentleman who had been building those lines and give

AT THE TELEPHONE CONVENTION—A CORNER IN THE WILLIAMS-ABBOTT ELECTRIC COMPANY'S EXHIBIT.

him a permanent position. It costs us from $220 to $427 a mile to do it.

Mr. Baird: I would like to hear from some gentlemen who have had experience with toll-lines as to how they overcome the conflicting interests of the different companies. Take a company whose line would cover a whole county, perhaps run into two counties; on account of the Bell people giving free service over the same district they have to give free service also. Now, how do they connect up these toll-lines so as to overcome these conflicting interests?

Mr. Fisher: There is one point, particularly, that I want to not exactly take exception to, but make a suggestion about; that because the Bell people give free service we have to do the same thing. I don't think there is any "because" in that. Our experience in Michigan, where the independent company charges a fair price for good service, is that if the Bell company gives absolutely free service in that community, the Bell company is not in it. [Applause.] I believe it is time that we look each other in the face. If we talk right to the community we can get good fair pay for fair service. We have had numerous instances in our state, and I know there are plenty of such instances in Ohio where the people of the entire community, substantially, have refused free service. The people of Michigan and the people of Ohio and the people of Indiana are like the people in the rest of these United States. You make them understand what is at issue and what they ought to do and they will do it every time. That "because" I want left out, if you please. [Applause.]

Mr. Harvey: I agree with the gentleman from Michigan. We got our lines together, all the independent telephone companies that cover some of the biggest counties, Oregon, Scott, Greene and adjoining counties, where the Bell people charge 15 cents for 10, 15 or 20 miles, and we charge 25 cents, and the people always come to us. They have not started their absolutely free service yet, but we hope they will in a short time, because

AT THE TELEPHONE CONVENTION—EXHIBIT OF HARVARD ELECTRIC CO., CHICAGO.

we want to show them that the people will patronize us anyhow. I can show instances where the Bell people are not getting the patronage at all, while we are getting it, and they are charging less prices than we are.

Mr. Ottenstaat: I would like to ask the gentleman who just had the floor what arrangement he makes with his neighbors about charges.

Mr Harvey: When a company comes to us, we agree that—"You use your line and we will use your line, and you take the money that you get and we will take the money that we get." [Laughter.]

Mr. Reutinger: I would like to ask the gentleman a question as to what he does in case he sends a message over the lines of another company, an intermediate company.

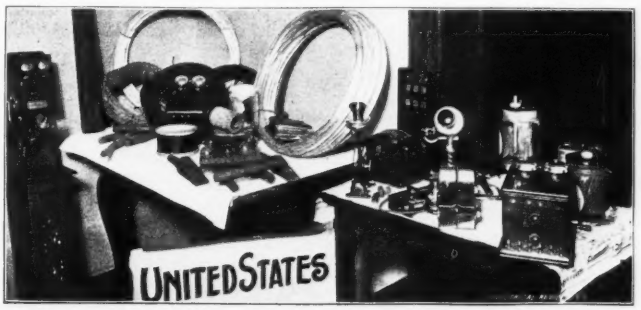
Mr. Harvey: Three companies have united under that plan, and there are several more who want to unite under the same plan. In the case of the three companies that have united, if the message goes clear over one man's line, it is all right; they only use the line for a few minutes and he uses ours, and it all comes out right in the end. It is the same as if it was all under one company's control.

Mr. Hill: We are operating on the same plan as the gentleman who last spoke, in four counties, centering in Clinton, Iowa, with 1,300 telephones on the reciprocal plan—James G. Blaine's plan. They carry our business and we carry theirs. Mr. Potter, of Lee County, who sits over yonder, is in it, and the Clinton company, the Carroll County company and ours, and Whiteside and Harrison County, and there is about between $80,000 and $100,000 invested in the business, and we work entirely upon that plan, except in the case of non-subscribers, and we are succeeding admirably.

Mr. Fair: We work on that plan—the mutual plan—with other companies with one exception, and that company we charge 60 per cent on outgoing business and they get 40 per cent, and of the business that comes in they take 60 per cent and we get 40 per cent. With the exception of that one company we take all we get. We take all the outgoing business and they take the business the other way, and we find that it works very satisfactorily. We have kept track of it, and there isn't enough difference to pay for keeping the books, pay for keeping the accounts. We have kept careful account of that and we have been running over four years on independent business, and there has not been enough difference in the business to pay for keeping the account. But where we worked through three companies, we work on a percentage, 50, 25 and 25. But most of the business is done by the companies taking all they get going out, and the other company taking all they get the other way. There is one company that we work with where we take 60 per cent and give them 40 per cent, and they do the same way when they take it in.

Mr. Reutinger: It is an easy matter to figure out and make a card rate from one point to another, and from that point to another, and divide the rate on a certain percentage as to the mileage, and we know just exactly where we stand.

Mr. Critchfield: I know a number of exchanges in which the plan suggested by the gentleman from Illinois has been adopted, each company keeping all it gets. Now, under that arrangement, the bigger company will get more money than the small one. If one company has 10 toll-stations on its lines and another one has a 100, the one with a 100 stations in the natural course of events, the latter company, would get 10 times as much business starting on its lines as the connecting company with 10 stations. I know of three companies adjoining each other that carried on business that way, starting as an experiment, and they kept books for two years, and one company was $2.82 behind what it would have been by dividing the business, and another company was less than that behind what it would have been. A 86 bill would have covered all three of them. That won't pay for keeping the books. I have in mind a system that is operated by five companies covering 11 adjacent counties. They make a certain rate from any point in one of the counties to any point in the next adjacent county. Ordinarily the rate to the first station is 10 cents. But that is not material for the purpose of this statement. It may be 15, 20, 25 cents, or whatever it may be. For instance, a message from five miles inside of A county, goes entirely across B county next adjacent, A and B divide that message equally, except 25 per cent of it goes to the originating company in all cases as an inducement for all companies to strive to create business on their lines. The originating company gets 25 per cent of the toll charged, and the remaining 75 per cent is divided between the companies operating in the two counties. Experience has shown that the variation from an exact division under that method is so slight that it will not begin to pay the cost of the books and the bookkeeping undertaking to keep it on the mileage basis.



INDEPENDENT TELEPHONE CONVENTION EXHIBIT OF THE UNITED STATES TELEPHONE MANUFACTURING COMPANY OF ST. LOUIS.

EXHIBIT OF THE EUREKA ELECTRIC COMPANY OF CHICAGO.

EXHIBIT OF THE NATIONAL CARBON COMPANY OF CLEVELAND.

The proper system is to build toll-lines to connect all the independent exchanges at the different points, leaving to the local companies the business in their own county, letting them carry the business in their own county over their own lines; and if they receive a message and want it transmitted 100 miles, it goes to the exchange point in the county seat, and there it is transferred to the long-distance line which is built as well as any line can be built, and taken to its destination on the percentage basis. In other words, we realized long ago that we could afford to give up the business of the adjacent county seat if we could get the business of the balance of the county on a percentage basis from connecting lines. In other words, we realize that if the local lines take only such business as they can manage, and the trunk lines can get the business from the eight or ten counties over its own and other similar connecting lines, it would be money in our pockets not only, on a commission basis, but materially strengthen our exchange if we could say to our patrons and to the public, "We will transact your business over as good lines as can be built for about 60 per cent of what you are now paying." We have got the business, and we can't fail to get the business. As has been said by our friend from Illinois, the people will stay with the home company, if you give good service and treat them fairly. Sentiment will do it for awhile, but sentiment will only last until it finally becomes a question with the larger exchanges of the best service for the least money. I believe the best system is for the originating company to take 25 per cent and then divide the other 75 per cent equally, each doing the same; that it will give the best result. [Applause.]

Mr. Cockrell: We have toll-lines connecting with lines from the south part of the state, down near Missouri, to the north part. We have never divided up our tolls. We have dealt upon the same plan as stated by our friend from Illinois, each man keeps what he gets, and so far, although we have kept a check on the business and might settle some time, we have never done it so far. We have found it very satisfactory. It seems to me that the building of trunk lines or long-distance lines is the only practical method for that class of business, so that we can turn over that to the long-distance companies.

Mr. Fricker: The Jefferson and Warren companies in Ohio, when they went to ask for a franchise in Jefferson County, found that the Ashville Council was made up of politicians almost entirely, shrewd, sharp men. They said, "We will grant you a franchise on the condition that every subscriber shall have free toll service throughout the county." They were obliged to accept it.

ADVANCE INFORMATION

New Incorporations.

CAMDEN, N. J.—The Twentieth Century Manufacturing Company has been incorporated with the County Clerk. The object of this corporation is to deal in patented mechanical and electrical devices. The capital stock is $125,000. The corporators are Ferrand Solomon, W. S. McKean and J. A. Rennie.

CHICAGO, ILL.—The Chase Electric Sign Company has been incorporated to manufacture electric letters, signs, emblems and accessories; incorporators, Charles A. Chase, K. P. Peck, A. B. Wilson; capital, $10,000.

NEW YORK, N. Y.—The National Wheel and Traction Company has been incorporated to manufacture motor vehicles, etc.; capital, $16,000; incorporators, A. Ohlsen, F. S. Dickinson, L. T. Noonan, all of New York city.

Increase of Capital.

NEW YORK, N. Y.—The Southwestern Telegraph and Telephone Company has increased its capital stock from $5,000,000 to $7,000,000.

CHICAGO, ILL.—The Illinois District Telephone Company has increased its capital stock from $100,000 to $200,000.

New Telephone and Telegraph Companies.

HARRISBURG, PA.—The Susquehanna Telephone and Telegraph Company, to furnish a telegraphic service in Dauphin, Northumberland, Perry, Schuylkill, Juniata and Snyder counties, has been incorporated; capital, $500. The incorporators are J. E. Kahler, Killinger; E. H. Leffler, J. H. Rowe, Millersburg; F. W. Lenker, Killinger; E. E. Koppenhaver, H. M. Bonawitz and George M. Lenker, Rife.

SALEM OHIO—The Columbiana County Telephone Company has been incorporated by Solon C. Thayer, W. D. McKeefer, G. S. Walton, G. E. Sebring, W. C. Morron and N. S. Hawkins. The capital stock is $200,000.

DULUTH, MINN.—The Duluth Telephone Exchange Company has been incorporated; capital, $500,000; incorporators, Edw. Lomasney, C. M. Mansean, James Wanless, Charles Mallinson, all of Duluth; Alex. W. Stow, Superior, Wis.

ELIZABETH, PA.—The Elizabeth Telephone Company has been incorporated; capital, $5,000; incorporators, E. P. Van Kirk, W. P. Wylie, A. F. Peairs, A. D. Pierce, A. J. Walker, all of Elizabeth.

WINCHESTER, IND.—The Eastern Indiana Telephone Company has been incorporated; capital stock, $500; directors, Volney H. Huston, John E. Markle, Albert B. Diggs, J. H. Fletcher, John R. Engle, George E. Leggett, E. S. Goodrich.

ALBANY, N. Y.—Articles of incorporation of the Glen Telephone Company, of Montgomery County, with a capital of $10,000, has been filed with the Secretary of State. Its operations are to be carried on from the town of Glen, and will connect with nearly all of the principal cities, towns and villages in the state. The directors are J. S. Glen Edwards, A. Marshall Burt, Andrew A. Turnboul, Jacob W. Shelp, Edward Edwards, of Glen; Howard A. DeGraff, of Fonda, and Edward C. Evans, of New York city.

LITTLETON, N. H.—The New England Telephone Company is to build a new line between this place and Bethlehem.

MOORESVILLE, TEX.—The Mooresville & Waco Telephone Company has been incorporated with a capital stock of $1,000; incorporators, J. E. Brown, Robert Brown, P. A. Clark and others.

HELENA, MONT.—The Lewistown Telephone Company has been incorporated with the Secretary of State by Frank E. Wright, Austin W. Warr and T. Jefferson Warr, all of Fergus County. Capital, $10,000. A telephone line will be constructed and maintained between Lewistown, Gilt Edge and Oka.

New Electric Railways.

MUNCIE, IND.—The Muncie, Anderson & Indianapolis Street Railroad Company has been incorporated with a capital of $2,000,000 to run a line from Muncie to Indianapolis by way of Anderson, Pendleton, Ingalls and Fortville. The directors are G. F. McCulloch and W. C. Sampson, of Muncie; Charles L. Henry, E. C. Carpenter and J. A. Van Osdal, of Anderson. The main offices will be at Muncie.

BUTLER, PA.—A charter has been granted to the Butler Passenger Railway Company to construct a street railway in the borough of Butler, to be about eight miles in length; capital stock, $50,000; directors, A. L. Reiber, president J. V. Ritts, John Berg, James B. McJunkin, Charles Duffy and A. L. Reiber, all of Butler, Pa.

CHICAGO, ILL.—The proposition to build an electric line from this city to St. Louis has been revived, with fair prospects of success. Its trains will run from 80 to 125 miles an hour. The estimated cost of the road is $10,000,000, and committees have been organized for putting the enterprise squarely upon its feet.

TURNER'S FALLS, VT.—The stockholders of the Greenfield & Turner's Falls Electric Railroad have voted to increase the capital stock $30,000, and to extend the tracks from Lake Pleasant to Montague.

MILLBURY, MASS.—The Selectmen of Northbridge have granted a franchise to the Worcester & Blackstone Valley Street Railway Company, to extend the line from Rochdale to Whitinsville, four miles. The line is to be built at once, and will give the town a through line to Worcester via Millbury, where the valley road connects with the Worcester & Suburban Road.

Electric Light and Power.

ABILENE, TEX.—An electric light plant is to be established at this place.

DEPEW, N. Y.—The Depew Lighting and Fuel Company has been incorporated, with a capital stock of $30,000, to produce and sell gas for light and fuel in the villages of Depew and Lancaster. The directors for the first year are Sampson Q. Mingle and Abel H. Gilbert, of New York, and S. Jay Ohart, of Depew.

WHITE PLAINS, N. Y.—The Mount Kisco Lighting Company has been incorporated; capital, $20,000; incorporators, D. Cromwell, C. D. Horton, R. B. Goodman, all of White Plains; H. G. Runkle, Plainfield, N. J.; T. E. Carpenter, Mount Kisco.

TRENTON, N. J.—The New Jersey Gas, Oil and Electric Lighting Company, with a capitalization of $20,000, has been incorporated. The officers of the company are: President, Michael Hurley; secretary, Howard Heath; treasurer, Welling G. Sickel. The directorate is composed of the foregoing officers and the following: Watson H. Linburg, Charles M. Heath and Harper F. Smith.

EL PASO, TEX.—The International Light and Power Company has been incorporated; capital stock, $25,000; purpose, to erect, operate and maintain an electric light and a power plant in El Paso, Tex., and Juarez, Mexico. Incorporators, J. P. Dieter, J. J. Kyler, W. S. McCutcheon and others.

SPENCER, MASS.—The Citizens' Gas and Electric Light Company has been incorporated; capital, $60,000; incorporators, E. Jones, F. A. Drury, N. Sagendorpt.

PRINCETON, MINN.—The contracts for the construction of waterworks and electric light plants at this place have been let to W. I. Gray & Company, of Minneapolis, the cost not to exceed $17,000, and work to commence forthwith.

CAVENDISH, VT.—The Vermont Electric Light and Power Company has been incorporated; capital, $100,000; incorporators, E. G. White, C. E. Ongley, Nellie E. Whitcomb, Nellie C. White, C. W. Whitcomb, all of Cavendish.

CHELSEA, VT.—The Chelsea Electric Light and Power Company has been incorporated; capital, $10,000; incorporators, W. F. Davis, E. D. Burnes, Viola Davis, of Chelsea; H. M. Dufur, Waterbury; C. F. Smith, Topsham.

ELECTRIC RAILWAY NOTES.

The Newark & Granville Electric Road, with headquarters at Newark, Ohio, has been appraised at $248,000. Sales of the road have been ordered by the courts.

The Metropolitan Street Railway Company, of New York city, has decided to issue $5,000,000 of treasury stock, making the outstanding stock $45,000,000,000.

The Terre Haute, Ind., Electric Street Railway Company and the Citizens' Electric Light and Power Company plants have been sold to Stone & Webster, of Boston, for $560,000.

At the annual meeting of the Metropolitan Street Railway Company, of Kansas City, the Armour interest came into control of the property. The earnings for the past year were at the rate of seven and one-half per cent on the capitalization, $5,500,000. The company now controls all the street-car lines of Kansas City.

The Paterson, N. J., Central Electric Railway has been sold under foreclosure proceedings to Albert A. Wilcox, law partner of Vice-President Hobart. Mr. Wilcox bid the property in for Mr. Hobart and Colonel Barbour, who were holders of the majority of the stock. The road will probably be under the management of the syndicate which is buying up all the north Jersey lines.

The first street railway in Seoul, capital of Korea, is nearing completion. H. R. Bostwick, chief engineer of the syndicate which is constructing the road, has sent here for 10 or 15 experienced motormen and several first class electrical engineers, who are to be sent to Korea immediately. The motormen will be sent from San Francisco, their wages being fixed at $70 per month.

The Springfield, Vt., Electric Railroad Company elected the following directors at its recent annual meeting: Adna Brown, E. C. Crosby, M. A. Coolidge, F. S. Coolidge, C. W. Wyman. The directors chose E. C. Crosby, president and general manager, and A. J. Crosby, clerk and treasurer. The gross receipts the past year were $29,327.67, and after deducting expenses the amount left was $9,467.64. The general manager reported that $3,877.92 had been expended in new construction during the year. The number of passengers carried exceeded 69,000.

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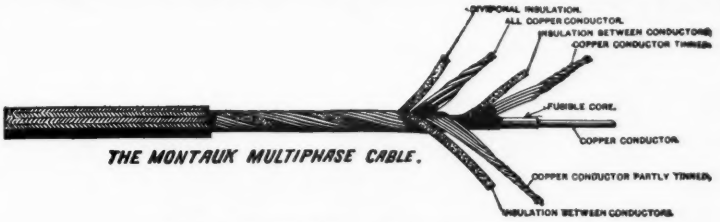

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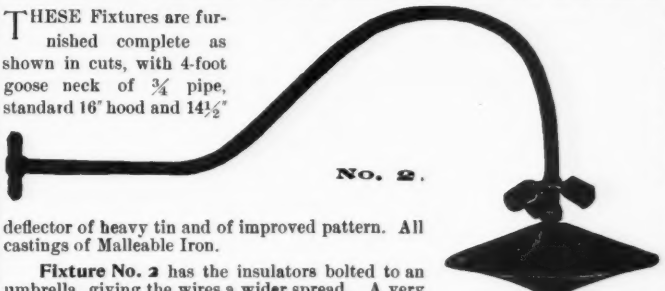

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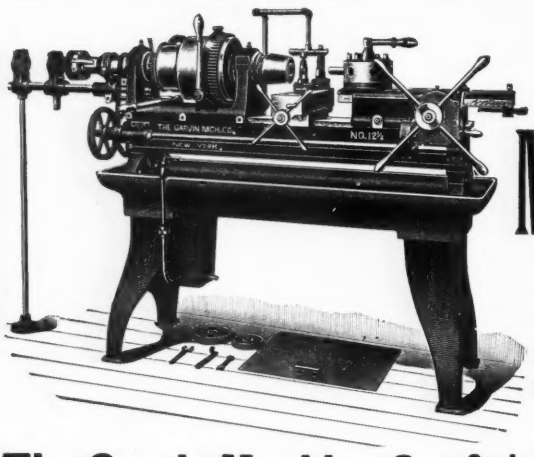

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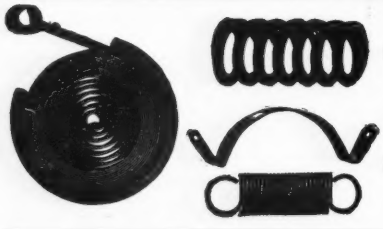

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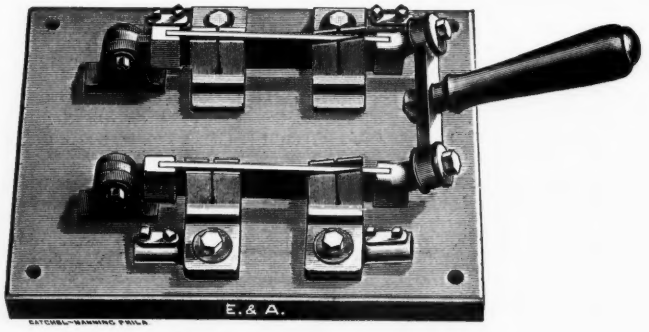

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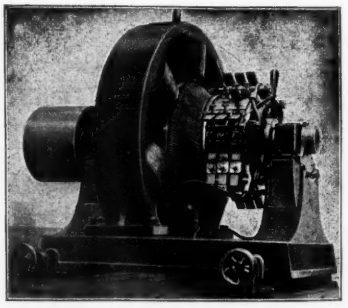

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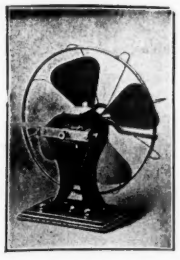

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Ball & Wood Co.

Fans and Fan Motors.
Central Electric Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Paragon Fan & Motor Co.
Warren Electric & Specialty Co.

Fiber.
Kartavert Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.

Instruments (Testing and Recording.)
Bristol Co., The
General Electric Co.
General Incandescent Arc Light Co.
Machado & Roller.
Keystone Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Kartavert Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Junction Boxes.
Bossert Electric Construction Co.
General Incandescent Arc Light Co.
Ward Leonard Electric Co.

Lamps, Arc.
Central Electric Co.
Diehl Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Standard Thermometer & Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative.
Central Electric Co.
Edison Decorative & Miniature Lamp Co.
General Incandescent Arc Light Co.

Lamps, Incandescent.
American Endoscopic Co.
Buckeye Electric Co.
Edison Decorative & Miniature Lamp Co.
General Electric Co.
General Incandescent Arc Light Co.
Gilmore Electric Co.
New York & Ohio Co.
Ohio Electric Works.
Osburn Electric Mfg. Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Sperry, B. N.
U. S. Battery Co.
Westinghouse Electric & Mfg. Co.

Lightning Arresters.
Garton-Daniels Electric Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Machine Tools.
Garvin Machine Co.

Mast-Arms.
Brady, T. H.
Meserve, F. W.

Meters.
Fort Wayne Electric Works.

Mica.
Munsell, Eugene.

Name-Plates.
Becker Name-Plate Co.

Non-Magnetic Watches.
Becken, A. C.

Paint.
Standard Paint Co.

Patent Solicitors.
Duvall, Edw. S.
Thornberry, Henry S.

Platinum.
Baker & Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.
Morris, Elmer P.
Roebling's Sons Co., John A.

Railway Specialties (Electric).
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.

Rheostats.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
Ohio Electric Specialty Mfg. Co.
Ward Leonard Electric Co.

Schools.
American School of Correspondence.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools
United Correspondence Schools.

Soldering Sticks.
Allen & Co., L. B.

Specialties.
G. & E. Electric Co.
General Incandescent Arc Light Co.
Ohio Electric Works.

Steel Spring Wire.
Boker & Co., Hermann.
Cary Spring Works
Manross, F. A.
Wallace Barnes Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Large & Co.
Western Electric Co.

Switches, Etc.
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Evanson & Armpriester.
General Electric Co.
General Incandescent Arc Light Co.

Switches, Etc.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Jones & Son, J.
Large & Co.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Bunnell & Co., J. H.
Central Electric Co.
Central Telephone & Electric Co.
Connecticut Telephone & Electric Co.
Eureka Electric Co.
Farr Telephone and Construction Co.
Gordon, A. Y.
Harvard Electric Co.
Illinois Electric Co.
Mianus Electric Co.
Murdock & Co., Wm. J.
National Automatic Telephone Co.
New York Telephone Co.
North Electric Co.
Ohio Electric Works.
Pennsylvania Electric Co.
Reliable Electric Mfg. Co.
Standard Telephone & Electric Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg. Co
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Telephone Mfg. Co.
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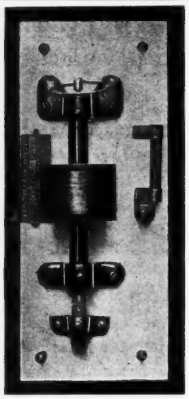

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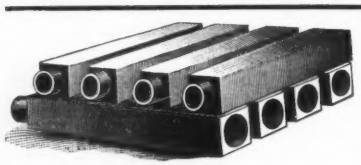

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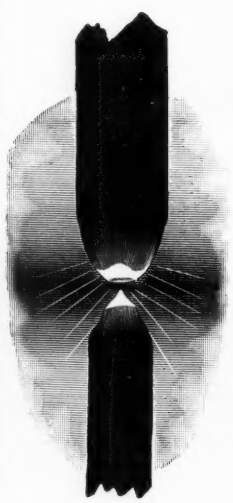

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